APPENDIX D

METALS AND OTHER ELEMENTS, MERCEDES

TABLE D-1. MINIMUM DETECTABLE EMISSIONS FOR METALS AND OTHER ELEMENTS[a]

	Emissions in mg/mi		
	FTP[b]	HFET	NYCC
Sodium[c]	0.10	0.07	0.60
Magnesium	0.01	0.01	0.04
Aluminum	0.01	0.01	0.08
Silicon	0.01	0.01	0.08
Phosphorus	0.01	0.01	0.05
Sulfur	0.01	0.01	0.05
Chlorine	0.01	0.01	0.04
Potassium	0.01	0.01	0.02
Calcium	0.01	0.01	0.05
Titanium	0.01	0.01	0.06
Vanadium	0.05	0.03	0.28
Chromium	0.10	0.08	0.63
Manganese	0.08	0.06	0.48
Iron	0.07	0.05	0.41
Cobalt	0.06	0.05	0.40
Nickel	0.06	0.04	0.37
Copper	0.07	0.05	0.44
Zinc	0.07	0.05	0.44
Arsenic	0.10	0.08	0.64
Selenium	0.12	0.09	0.73
Bromine	0.20	0.15	1.40
Strontium	0.50	0.36	3.50
Molybdenum	1.60	1.20	9.80
Cadnium	0.01	0.01	0.04
Tin	0.05	0.04	0.30
Antimony	0.02	0.02	0.14
Iodine	0.03	0.02	0.17
Cesium	0.03	0.02	0.19
Barium	0.03	0.02	0.20
Platinum[c]	0.25	0.19	1.50
Mercury[c]	0.25	0.20	1.70
Lead	0.75	0.55	4.80

[a]The following are the minimum detectable emission levels for each element and driving cycle, however, the emissions have not been quantified in the following tables unless the emissions are 3 times or greater than the detection limit. Emissions greater than the detection limit but less than three times the detection limit have been designated as trace levels T.

[b]The FTP detection limits are for a 23-minute UDDS cycle of the FTP (i.e., the 505 second cold/hot-start segment plus the 867 stabilize segment). Reported FTP emission rates may be lower than the apparent level of quantification if an element was detected during only one of the two UDDS cycles.

[c]Uncorrectable systematic biases were suspected during many of the analyses for these elements.

TABLE D-2. TRACE METALS AND OTHER ELEMENTS, MERCEDES BASELINE WITH TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 1-3	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Sodium						
Magnesium						
Aluminum						
Silicon	T	T	T			
Phosphorus	T					
Sulfur	0.26	0.22	0.14	0.12	0.34	0.25
Chlorine	0.04		T			
Potassium	0.01	T				
Calcium	0.23	0.05	0.06	T	0.16	0.46
Titanium	T	T				T
Vanadium						
Chromium	T	T	T	T	3.39	T
Manganese			T			
Iron	1.50	1.39	0.69	0.40	3.30	2.94
Cobalt						
Nickel	0.20	0.20	0.15		T	T
Copper	T	T	T	T	T	
Zinc	T	T	T			
Arsenic	T	T		T		
Selenium	T	T	T			
Bromine						
Strontium						
Molybdenum						
Cadmium						
Tin						
Antimony						
Iodine						
Cesium						
Barium						
Platinum	T	T			T	
Mercury		T				
Lead			T			T

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-3. TRACE METALS AND OTHER ELEMENTS, MERCEDES BASELINE WITHOUT TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Sodium						
Magnesium	0.05	0.04	0.03	T	T	
Aluminum	T					
Silicon	0.12	0.10				
Phosphorus	0.14	0.16	0.08	0.07	0.23	0.23
Sulfur	1.76	1.78	0.90	0.82	3.08	2.52
Chlorine	0.03	T				
Potassium	0.01	0.08	T	T		
Calcium	0.11	0.10	0.04	0.04	0.24	0.20
Titanium	T	T				T
Vanadium						
Chromium	0.28	0.23	T	0.19	1.63	T
Manganese	T	0.10				
Iron	4.90	3.30	0.69	0.50	5.74	3.69
Cobalt						
Nickel	0.26	0.74	0.22	0.16	1.71	1.30
Copper	T	T	T	T	T	
Zinc	0.12	0.12	0.14	T	T	T
Arsenic	T	T		T	T	
Selenium		T	T	T		
Bromine						
Strontium		T				
Molybdenum		T	T		T	T
Cadmium						
Tin	T					
Antimony	T					
Iodine	T					
Cesium	T					
Barium	T					
Platinum	T	T	T	T	T	T
Mercury		T		T		
Lead	T	T	T	T		

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-4. TRACE METALS AND OTHER ELEMENTS, MERCEDES BASELINE WITH REPLACEMENT TRAP, FTP TESTS

	Emissions in mg/mi FTP	
	Test 11-1	Test 11-2
Sodium		T
Magnesium	T	T
Aluminum	0.05	0.02
Silicon	0.05	0.04
Phosphorus	T	0.01
Sulfur	0.33	0.24
Chlorine	0.03	T
Potassium	0.01	T
Calcium	0.12	0.04
Titanium	T	T
Vanadium		
Chromium	T	0.12
Manganese	T	T
Iron	4.04	1.29
Cobalt	T	
Nickel	0.27	T
Copper	0.22	0.10
Zinc		T
Arsenic		0.16
Selenium		0.24
Bromine		
Strontium	T	T
Molybdenum	T	
Cadmium		
Tin		
Antimony	T	
Iodine		
Cesium		
Barium		
Platinum		
Mercury		T
Lead		

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-5. TRACE METALS AND OTHER ELEMENTS, MERCEDES WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL, FTP TESTS

	Emissions in mg/mi					
	FTP, with trap			FTP, without trap		
	Test 13-1	Test 13-2	Average	Test 4-1	Test 4-2	Average
Sodium		T	T			
Magnesium	0.03	T	0.02	0.04	0.01	0.03
Aluminum	0.01	0.03	0.02	0.08	0.02	0.05
Silicon	0.04	0.02	0.03	0.17	0.05	0.11
Phosphorus	0.01	0.01	0.01	0.16	0.10	0.13
Sulfur	0.12	0.29	0.21	1.49	0.81	1.15
Chlorine	0.01	T	0.01	0.11	0.07	0.09
Potassium	0.01	0.01	0.01	T		T
Calcium	0.07	0.05	0.06	0.09	0.05	0.07
Titanium		T	T	T		T
Vanadium						
Chromium	0.16	0.09	0.13	0.37	T	0.19
Manganese	T		T			
Iron	0.89	2.16	1.53	5.42	1.48	3.45
Cobalt					T	T
Nickel	T	0.12	0.06	0.91	0.26	0.59
Copper	0.14	0.10	0.12	0.13	T	0.07
Zinc				0.09	0.10	0.10
Arsenic	T		T	T	T	T
Selenium	T		T			
Bromine						
Strontium	0.83		0.42			
Molybdenum						
Cadmium	T		T			
Tin						
Antimony	T		T			
Iodine						
Cesium						
Barium						
Platinum				T	T	T
Mercury				T	T	T
Lead	T		T			

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-6. TRACE METALS AND OTHER ELEMENTS, MERCEDES LOADED TRAP (BASELINE FUEL) AND REGENERATION TESTS (BASELINE AND LOW AROMATIC)

	Emission in mg/mi					
	Loaded Trap NYCC Baseline Fuel	Regeneration HFET				
		Baseline Fuel		Low Aromatic Fuel		
		R-1	R-2	R-1	R-2	R-3
Sodium				T	T	0.33
Magnesium		0.04	T		T	
Aluminum		T		T	T	T
Silicon		0.20			T	
Phosphorus		T		T	0.09	T
Sulfur	0.96	1.35	0.34	0.75	0.69	0.25
Chlorine		0.17	T			
Potassium				T	T	T
Calcium	0.19	0.05	0.02	0.05	0.07	0.36
Titanium	T	T	T			
Vanadium		0.10	0.08			
Chromium	T	0.29	T	0.18	T	0.19
Manganese		T	T			T
Iron	12.5	12.6	2.24	0.53	0.56	0.54
Cobalt						
Nickel	2.47	1.92	0.48			T
Copper		0.30	0.12	0.15	T	0.16
Zinc		T		T		
Arsenic				T		
Selenium	T		T	T		
Bromine	T	T	T			
Strontium	T	T	T	T		
Molybdenum		T	T			
Cadmium						
Tin						
Antimony						
Iodine						
Cesium						
Barium					T	
Platinum	T		T			
Mercury						
Lead	14.6	1.73	1.75			

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-7. TRACE METALS AND OTHER ELEMENTS, MERCEDES WITH WORN INJECTORS AND TRAP

	Emissions in mg/mi		
	FTP	HFET	NYCC
	Test 15-1	Test 15-1	Test 15-1
Sodium	T	T	3.48
Magnesium	T		
Aluminum	0.02	T	
Silicon	T		
Phosphorus	0.01		
Sulfur	0.31	0.24	T
Chlorine	T		
Potassium	T		
Calcium	0.06	T	1.26
Titanium	T	T	
Vanadium		T	
Chromium	0.14	T	
Manganese	T		T
Iron	0.52	0.50	2.69
Cobalt			
Nickel	T		T
Copper	T	0.16	T
Zinc			
Arsenic			
Selenium			
Bromine			
Strontium	T	T	
Molybdenum			
Cadmium			
Tin			
Antimony			
Iodine			
Cesium			
Barium			
Platinum			
Mercury			
Lead			

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-8. TRACE METALS AND OTHER ELEMENTS, MERCEDES WITH RETARDED TIMING AND TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 17-1	Test 17-2	Test 17-1	Test 17-2	Test 17-1	Test 17-2
Sodium						
Magnesium	T	T				
Aluminum	T					
Silicon	T	0.01				
Phosphorus						
Sulfur	0.17	0.18	0.18	0.17	T	0.14
Chlorine						
Potassium	T	0.02				T
Calcium	0.08	0.12	T	T	T	T
Titanium	0.04	T				
Vanadium						
Chromium	0.17	0.08	T	T	1.21	T
Manganese	T	T				
Iron	0.38	0.44	0.14	T	T	
Cobalt						
Nickel	T	T				
Copper						
Zinc	T	T				
Arsenic						
Selenium						
Bromine						
Strontium		T				
Molybdenum						
Cadmium						
Tin						
Antimony						
Iodine						
Cesium						
Barium						
Platinum						
Mercury						
Lead						

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-9. TRACE METALS AND OTHER ELEMENTS, MERCEDES WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 8-1	Test 8-2	Test 8-1	Test 8-2	Test 8-1	Test 8-2
Sodium						
Magnesium	0.04	0.04	0.02	0.02	T	T
Aluminum	0.02	0.03	T			
Silicon	0.03	0.06	T	T		
Phosphorus	0.08	0.11	0.04	0.05	0.14	0.11
Sulfur	1.31	1.73	1.04	1.22	1.43	1.73
Chlorine		T				
Potassium		T	T		0.26	
Calcium	0.06	0.07	0.04	0.03	0.44	T
Titanium						
Vanadium						
Chromium	T	T	0.16	T	T	1.41
Manganese	T	T				
Iron	1.34	1.43	0.13	0.31	T	
Cobalt						
Nickel	0.19	0.22	T	T	T	
Copper						
Zinc	T	0.11	T	T		T
Arsenic	T					
Selenium						
Bromine						
Strontium	T					
Molybdenum						
Cadmium						T
Tin						
Antimony						
Iodine						
Cesium						
Barium						
Platinum						
Mercury						
Lead	T			T		

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-10. TRACE METALS AND OTHER ELEMENTS, MERCEDES WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi	
	FTP, with trap Test 19-1	FTP, without trap Test 10-1
Sodium	T	
Magnesium	T	0.03
Aluminum		0.02
Silicon		0.02
Phosphorus		0.08
Sulfur	0.05	0.80
Chlorine		T
Potassium		T
Calcium	0.01	0.05
Titanium		
Vanadium		
Chromium	T	T
Manganese		T
Iron	0.10	0.90
Cobalt		
Nickel		0.12
Copper		
Zinc		T
Arsenic	T	
Selenium	T	
Bromine		
Strontium	T	T
Molybdenum		
Cadmium		
Tin		
Antimony		
Iodine		
Cesium		
Barium		
Platinum		
Mercury		
Lead		

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE D-11. BACKGROUND RESULTS FOR TRACE METALS AND OTHER ELEMENTS

	Weight of Element on Filter, μg			Comparable Level for FTP, mg/mi[a]		
	Filter 1	Filter 2	Filter 3	Filter 1	Filter 2	Filter 3
Sodium	b					
Magnesium		T[c]	T		T	T
Aluminum		T			T	
Silicon		T			T	
Phosphorus						
Sulfur		T			T	
Chlorine						
Potassium		T	T		T	T
Calcium		0.9	0.8		0.12	0.10
Titanium						
Vanadium						
Chromium		1.6	T		0.21	T
Manganese			T			T
Iron		T	T		T	T
Cobalt						
Nickel						
Copper			T			T
Zinc						
Arsenic						
Selenium						
Bromine			2.6			0.35
Strontium			4.8			0.64
Molybdenum			T			T
Cadmium						
Tin						
Antimony						
Iodine						
Cesium						
Barium						
Platinum						
Mercury						
Lead			12.3			1.65

[a]Calculated as a comparison value only from average FTP test parameters and weight of element on filter. Value has no meaning other than to present the background data in a form that can be compared to the vehicle data.
[b]Blank space signifies that the emission rate of the element was below the detection limit for the procedure.
[c]T signifies that the element was detected, but below the limit of quantification.

APPENDIX E

METALS AND OTHER ELEMENTS, VOLKSWAGEN

TABLE E-1. MINIMUM DETECTABLE EMISSIONS FOR METALS AND OTHER ELEMENTS[a]

	Emissions in mg/mi		
	FTP[b]	HFET	NYCC
Sodium[c]	0.10	0.07	0.60
Magnesium	0.01	0.01	0.04
Aluminum	0.01	0.01	0.08
Silicon	0.01	0.01	0.08
Phosphorus	0.01	0.01	0.05
Sulfur	0.01	0.01	0.05
Chlorine	0.01	0.01	0.04
Potassium	0.01	0.01	0.02
Calcium	0.01	0.01	0.05
Titanium	0.01	0.01	0.06
Vanadium	0.05	0.03	0.28
Chromium	0.10	0.08	0.63
Manganese	0.08	0.06	0.48
Iron	0.07	0.05	0.41
Cobalt	0.06	0.05	0.40
Nickel	0.06	0.04	0.37
Copper	0.07	0.05	0.44
Zinc	0.07	0.05	0.44
Arsenic	0.10	0.08	0.64
Selenium	0.12	0.09	0.73
Bromine	0.20	0.15	1.40
Strontium	0.50	0.36	3.50
Molybdenum	1.60	1.20	9.80
Cadnium	0.01	0.01	0.04
Tin	0.05	0.04	0.30
Antimony	0.02	0.02	0.14
Iodine	0.03	0.02	0.17
Cesium	0.03	0.02	0.19
Barium	0.03	0.02	0.20
Platinum[c]	0.25	0.19	1.50
Mercury[c]	0.25	0.20	1.70
Lead	0.75	0.55	4.80

[a]The following are the minimum detectable emission levels for each element and driving cycle, however, the emissions have not been quantified in the following tables unless the emissions are 3 times or greater than the detection limit. Emissions greater than the detection limit but less than three times the detection limit have been designated as trace levels T.

[b]The FTP detection limits are for a 23-minute UDDS cycle of the FTP (i.e., the 505 second cold/hot-start segment plus the 867 stabilize segment). Reported FTP emission rates may be lower than the apparent level of quantification if an element was detected during only one of the two UDDS cycles.

[c]Uncorrectable systematic biases were suspected during many of the analyses for these elements.

TABLE E-2. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN BASELINE WITH TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 1-1	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Sodium		T	T		T	
Magnesium						
Aluminum	0.01	T	T			T
Silicon	T	0.02	T			
Phosphorus						
Sulfur	0.14	0.08	0.07	0.04	0.22	T
Chlorine	T	0.01	0.02			T
Potassium	T	T				
Calcium	0.02	0.04	0.02	T	T	T
Titanium	T	T				T
Vanadium						
Chromium	0.11	T	T	0.20	T	2.61
Manganese	T					
Iron	1.08	0.72	0.60	0.45	3.83	2.54
Cobalt	T					
Nickel	T	T	T	T	T	1.01
Copper	T			T		T
Zinc			0.14			
Arsenic		T		T		
Selenium		T		T		
Bromine					T	
Strontium						
Molybdenum			T			
Cadmium						
Tin						
Antimony						
Iodine						
Cesium						
Barium		T				
Platinum	T	T		T	T	T
Mercury				T		
Lead						

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-3. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN BASELINE WITHOUT TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Sodium	T	T				
Magnesium	T	0.01	T	T		
Aluminum	0.01	0.01				
Silicon	T	T		T		
Phosphorus	0.05	0.05	0.03	0.02	T	T
Sulfur	0.79	0.64	0.55	0.48	1.07	0.99
Chlorine	0.02	0.01	T		T	T
Potassium					T	
Calcium	0.07	0.08	0.03	0.04	T	0.18
Titanium					T	
Vanadium						
Chromium	T	T	T	T	T	T
Manganese	T	T	T	T		T
Iron	1.25	0.94	0.54	0.46	2.64	2.60
Cobalt						
Nickel	T	0.07	T	T	T	T
Copper	T	T	T		T	
Zinc	T	T	T	T	T	
Arsenic	T					T
Selenium	T			T		T
Bromine						
Strontium						
Molybdenum				T		
Cadmium						
Tin						
Antimony						
Iodine						
Cesium	T					
Barium						
Platinum	T	T	T	T	T	T
Mercury						T
Lead			T	T		

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-4. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL, FTP TESTS

	Emissions in mg/mi					
	FTP, with trap			FTP, without trap		
	Test 3-1	Test 3-2	Average	Test 4-1	Test 4-2	Average
Sodium						
Magnesium				T	T	T
Aluminum	0.05	0.02	0.04	0.04	0.03	0.04
Silicon	T	T	T	0.02	0.01	0.02
Phosphorus	T	T	T	0.03	0.04	0.04
Sulfur	0.16	0.06	0.11	0.04	0.36	0.20
Chlorine	T	0.01	0.01	T	0.01	0.01
Potassium	T	0.01	0.01	0.01	T	0.01
Calcium	0.08	0.11	0.10	0.10	0.08	0.09
Titanium	T	T	T			
Vanadium						
Chromium	0.10	T	0.05	T	0.12	0.06
Manganese	T	T	T	T	T	T
Iron	1.23	0.57	0.90	0.76	0.62	0.69
Cobalt						
Nickel	T		T			
Copper	0.08	0.12	0.10	T	T	T
Zinc	T		T	T	T	T
Arsenic	T	T	T		T	T
Selenium	T	T	T	T	T	T
Bromine						
Strontium		T	T			
Molybdenum						
Cadmium						
Tin	T	T	T			
Antimony						
Iodine						
Cesium						
Barium					T	T
Platinum						
Mercury						
Lead						

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-5. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN REGENERATION HFET TESTS WITH LOW AROMATIC FUEL

	Emissions in mg/mi		
	Regeneration HFET		
	Test R-1	Test R-2	Average
Sodium	T	0.40	0.20
Magnesium		T	T
Aluminum	0.06	0.05	0.06
Silicon	0.03	0.03	0.03
Phosphorus	T	0.01	0.01
Sulfur	0.23	0.26	0.25
Chlorine	T	T	T
Potassium	T	T	T
Calcium	0.14	0.07	0.11
Titanium	T		T
Vanadium			
Chromium	T	T	T
Manganese		T	T
Iron	0.99	1.09	1.04
Cobalt			
Nickel	T		T
Copper	0.19	0.16	0.18
Zinc			
Arsenic			
Selenium			
Bromine			
Strontium	T		T
Molybdenum			
Cadmium			
Tin			
Antimony			
Iodine			
Cesium			
Barium			
Platinum	T		T
Mercury	T		
Lead			T

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-6. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN WITH FAILED INJECTORS AND TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 5-3	Test 5-2	Test 5-1	Test 5-2	Test 5-1	Test 5-2
Sodium			T		T	
Magnesium						
Aluminum	T	0.01	T	T	T	
Silicon	T	0.01				
Phosphorus	T	T	T			
Sulfur	0.03	0.04	0.04	0.02		
Chlorine		T				
Potassium	0.01	0.06				
Calcium	0.06	0.10	0.02	0.01	T	T
Titanium		0.01				
Vanadium						
Chromium	0.14	0.13	T	T	T	T
Manganese	T	T	T			
Iron	0.45	0.48	0.36	0.30	1.54	1.89
Cobalt		T		T		
Nickel	T					
Copper	0.11	0.10	0.15	T	1.33	1.16
Zinc	T					
Arsenic						
Selenium						
Bromine						
Strontium		T		T		
Molybdenum						
Cadmium						
Tin						
Antimony						
Iodine						
Cesium						
Barium						
Platinum		T		T		
Mercury						
Lead						

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-7. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN WITH FAILED INJECTORS AND WITHOUT TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 6-1	Test 6-2	Test 6-1	Test 6-2	Test 6-1	Test 6-2
Sodium						
Magnesium	T	T		T	T	
Aluminum	0.02	0.02	T	T	T	T
Silicon	0.02	0.04		0.02	T	0.38
Phosphorus	0.04	0.03	0.02	0.03	0.08	0.07
Sulfur	0.56	0.51	0.35	0.41	0.79	0.75
Chlorine	0.02	0.02	T	T	T	T
Potassium	T	T	T	T	T	T
Calcium	0.17	0.17	0.02	0.07	0.37	1.08
Titanium	T		T	T	T	T
Vanadium						
Chromium	0.11	0.22	T	0.15	T	T
Manganese	T	T		T	T	
Iron	0.92	0.82	0.43	0.52	3.16	2.31
Cobalt		T		T		
Nickel			T	T		T
Copper	0.23	0.21	T	0.15	1.32	T
Zinc	T	T	T	T		
Arsenic					T	
Selenium		T			T	
Bromine	T					T
Strontium		T	T	T	T	
Molybdenum						
Cadmium						
Tin						
Antimony						
Iodine						
Cesium					T	
Barium			T	T		
Platinum						
Mercury						
Lead		T				

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-8. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN WITH RETARDED TIMING AND TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 7-1	Test 7-2	Test 7-1	Test 7-2	Test 7-1	Test 7-2
Sodium						
Magnesium	T	T			T	
Aluminum	T	T				
Silicon	T					
Phosphorus	T					
Sulfur	0.03	0.01	0.02			
Chlorine						
Potassium	T	T				T
Calcium	0.04	0.03		T	0.11	
Titanium	T					
Vanadium						
Chromium	T	T	T	T	T	T
Manganese		T	T			
Iron	0.13	0.11	T	0.10		
Cobalt						
Nickel						
Copper						
Zinc			T			
Arsenic					T	
Selenium	T					
Bromine						
Strontium				T		
Molybdenum				T		
Cadmium						
Tin						T
Antimony						T
Iodine						
Cesium						
Barium						
Platinum						
Mercury						
Lead				T		T

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-9. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in mg/mi					
	FTP		HFET		NYCC	
	Test 8-1	Test 8-2	Test 8-1	Test 8-2	Test 8-1	Test 8-2
Sodium						
Magnesium	0.01	0.01	T	T	T	T
Aluminum	0.01	T				
Silicon	0.09	0.06	0.02		T	T
Phosphorus	0.04	0.02	0.02	0.02	T	
Sulfur	0.40	0.34	0.24	0.28	0.44	0.31
Chlorine	0.01					
Potassium	T	T	T			T
Calcium	0.10	0.03	0.02	0.02	0.13	
Titanium						T
Vanadium						
Chromium	T	0.13	T	T	T	T
Manganese	T					
Iron	0.58	0.28	0.19	0.19	T	
Cobalt						
Nickel						
Copper						
Zinc	T		T		T	T
Arsenic						
Selenium						
Bromine						
Strontium		T				T
Molybdenum						
Cadmium						
Tin	T					
Antimony						
Iodine						
Cesium						
Barium					T	
Platinum						
Mercury			T			
Lead		T				

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-10. TRACE METALS AND OTHER ELEMENTS, VOLKSWAGEN WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL, FTP TESTS

	Emissions in mg/mi	
	FTP, with trap Test 9-1	FTP, without trap Test 10-1
Sodium		
Magnesium	T	0.01
Aluminum	T	0.01
Silicon		T
Phosphorus		0.04
Sulfur	0.03	0.36
Chlorine		
Potassium	T	T
Calcium	T	0.07
Titanium		
Vanadium		
Chromium	T	0.11
Manganese		
Iron	T	0.23
Cobalt		
Nickel		
Copper		
Zinc		T
Arsenic		
Selenium	T	T
Bromine		
Strontium		
Molybdenum		
Cadmium		
Tin		
Antimony		
Iodine		
Cesium		
Barium		
Platinum		
Mercury		
Lead		

Blank space signifies that the emission rate of the element was below the detection limit for the procedure.

T signifies that the element was detected, but below the limit of quantitation.

Uncorrectable systematic biases were suspected during a number of the analyses for sodium, platinum, and mercury.

TABLE E-11. BACKGROUND RESULTS FOR TRACE METALS AND OTHER ELEMENTS

	Weight of Element on Filter, μg			Comparable Level for FTP, mg/mi[a]		
	Filter 1	Filter 2	Filter 3	Filter 1	Filter 2	Filter 3
Sodium	b					
Magnesium		T[c]	T		T	T
Aluminum		T			T	
Silicon		T			T	
Phosphorus						
Sulfur		T			T	
Chlorine						
Potassium		T	T		T	T
Calcium		0.9	0.8		0.12	0.10
Titanium						
Vanadium						
Chromium		1.6	T		0.21	T
Manganese			T			T
Iron		T	T		T	T
Cobalt						
Nickel						
Copper			T			T
Zinc						
Arsenic						
Selenium						
Bromine			2.6			0.35
Strontium			4.8			0.64
Molybdenum			T			T
Cadmium						
Tin						
Antimony						
Iodine						
Cesium						
Barium						
Platinum						
Mercury						
Lead			12.3			1.65

[a]Calculated as a comparison value only from average FTP test parameters and weight of element on filter. Value has no meaning other than to present the background data in a form that can be compared to the vehicle data.
[b]Blank space signifies that the emission rate of the element was below the detection limit for the procedure.
[c]T signifies that the element was detected, but below the limit of quantification.

APPENDIX F

ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES

TABLE F-1. ALDEHYDES AND KETONES, SULFATE, AND PATICULATE SOLUBLE ORGANIC FRACTION, MERCEDES BASELINE WITH TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 1-3	Test 1-2	Avg	Test 1-1	Test 1-2	Avg	Test 1-1	Test 1-2	Avg
Formaldehyde	11.2	10.1	10.7	6.9	6.8	6.9	26.1	64.0	45.1
Acetaldehyde	8.0	7.4	7.7	5.6	5.1	5.4	13.8	24.0	18.9
Acrolein	3.0	3.2	3.1	ND	2.1	1.1	ND	7.4	3.7
Propionaldehyde	0.1	ND	0.1	ND	0.2	0.1	ND	ND	ND
Acetone	1.9	4.2	3.1	2.4	2.4	2.4	12.6	6.8	9.7
Crotonaldehyde	ND[a]	0.2	0.1	ND	ND	ND	ND	6.5	3.3
Isobutyraldehyde/MEK	0.8	0.9	0.9	0.2	ND	0.1	5.8	9.4	7.6
Benzaldehyde	0.2	2.2	1.2	ND	0.8	0.4	2.4	ND	1.2
Hexanaldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Aldehydes and Ketones	25.2	28.2	26.9	15.1	17.4	16.4	60.7	118.1	89.5
Sulfate	0.3	1.2	0.8	0.2	ND	0.1	0.6	ND	0.3
Particulate Soluble Organic Fraction, Percent	19.6	6.5	13.1	11.6	9.9	10.8	7.0	8.7	7.9

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

TABLE F-2. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES BASELINE WITHOUT TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 2-1	Test 2-2	Avg	Test 2-1	Test 2-2	Avg	Test 2-1	Test 2-2	Avg
Formaldehyde	20.2	21.4	20.8	17.8	13.4	15.6	43.6	44.1	43.9
Acetaldehyde	7.4	6.3	6.9	6.0	4.5	5.3	16.5	3.1	9.8
Acrolein	ND[a]	2.5	1.2	ND	2.2	1.1	ND	11.5	5.8
Propionaldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	NA[b]	NA	NA	NA	NA	NA	NA	NA	NA
Crotonaldehyde	1.2	0.6	0.9	0.6	0.5	0.6	2.3	ND	1.1
Isobutyraldehyde/MEK	2.7	2.5	2.6	2.3	2.4	2.3	4.6	4.9	4.8
Benzaldehyde	1.3	0.4	0.8	0.9	1.5	1.2	2.1	ND	1.1
Hexanaldehyde	ND	0.2	0.1	ND	ND	ND	ND	ND	ND
Total Aldehydes and Ketones	32.8	33.9	33.4	27.6	24.5	26.1	69.1	63.6	66.4
Sulfate	7.8	4.5	6.1	3.0	2.7	2.8	16.8	10.5	13.7
Particulate Soluble Organic Fraction, Percent	7.5	8.5	8.0	12.3	12.7	12.5	7.6	8.9	8.2

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.
[b]NA - Results not available.

TABLE F-3. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES BASELINE WITH REPLACEMENT TRAP, FTP TESTS

	Emissions in mg/mi, except as noted		
	FTP		
	Test 11-1	Test 11-2	Avg.
Formaldehyde	21.7	22.8	22.3
Acetaldehyde	6.2	5.7	6.0
Acrolein	ND[a]	1.4	0.7
Propionaldehyde	ND	ND	ND
Acetone	4.7	3.5	4.1
Crotonaldehyde	ND	ND	ND
Isobutyraldehyde/MEK	1.0	0.3	0.7
Benzaldehyde	0.7	ND	0.4
Hexanaldehyde	0.5	ND	0.3
Total Aldehydes and Ketones	34.8	33.7	34.3
Sulfate	2.4	1.3	1.9
Particulate Soluble Organic Fraction, Percent	7.2	16.3	11.8

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

TABLE F-4. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL, FTP TESTS

	Emissions in mg/mi, except as noted					
	FTP, with trap			FTP, without trap		
	Test 13-1	Test 13-2	Avg.	Test 4-1	Test 4-2	Avg.
Formaldehyde	12.7	17.7	15.2	23.8	16.0	19.9
Acetaldehyde	4.7	5.2	5.0	6.9	3.8	5.4
Acrolein	2.2	ND	1.1	ND	ND	ND
Propionaldehyde	ND[a]	ND	ND	ND	ND	ND
Acetone	1.5	3.2	2.4	5.4	2.8	4.1
Crotonaldehyde	0.1	1.0	0.6	ND	0.4	0.2
Isobutyraldehyde/MEK	0.5	0.8	0.7	0.8	ND	0.4
Benzaldehyde	ND	ND	ND	0.2	ND	0.1
Hexanaldehyde	ND	0.3	0.2	ND	ND	ND
Total Aldehydes and Ketones	21.7	28.2	25.0	37.1	23.0	30.1
Sulfate	1.1	1.2	1.2	4.6	3.5	4.1
Particulate Soluble Organic Fraction, Percent	16.4	6.8	11.6	7.5	7.9	7.7

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

TABLE F-5. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE SOLUBLE ORGANIC FRACTION, MERCEDES LOADED TRAP (BASELINE FUEL) AND REGENERATION TESTS (BASELINE AND LOW AROMATIC FUELS)

	Emissions in mg/mi, except as noted					
	Loaded Trap NYCC	Regeneration HFET				
		Baseline Fuel		Low Aromatic Fuel		
	Baseline Fuel	R-1	R-2	R-1	R-2	R-3
Formaldehyde	41.7	13.5	13.4	16.1	13.2	8.1
Acetaldehyde	11.2	3.9	3.4	8.3	6.0	4.9
Acrolein	ND[a]	ND	ND	ND	ND	ND
Propionaldehyde	ND	ND	ND	ND	ND	ND
Acetone	12.7	ND	1.6	4.6	2.6	2.1
Crotonaldehyde	ND	ND	0.2	2.4	ND	ND
Isobutyraldehyde/MEK	1.6	ND	ND	0.5	0.8	ND
Benzaldehyde	2.8	0.3	ND	ND	0.7	0.2
Hexanaldehyde	ND	ND	ND	ND	0.5	ND
Total Aldehydes and Ketones	70.0	17.7	19.6	31.9	23.8	15.3
Sulfate	NA[b]	NA	NA	3.8	4.0	2.2
Particulate Soluble Organic Fraction, Percent	6.9	5.5	NA	19.7	19.2	24.2

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.
[b]NA - Results not available.

TABLE F-6. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES WITH WORN INJECTORS AND TRAP

	Emissions in mg/mi, except as noted		
	FTP	HFET	NYCC
	Test 15-1	Test 15.1	Test 15.1
Formaldehyde	19.2	9.7	64.6
Acetaldehyde	5.5	2.4	21.7
Acrolein	ND[a]	ND	ND
Propionaldehyde	ND	ND	ND
Acetone	6.2	1.7	21.9
Crotonaldehyde	0.2	0.2	10.6
Isobutyraldehyde/MEK	ND	ND	ND
Benzaldehyde	ND	ND	ND
Hexanaldehyde	0.1	ND	ND
Total Aldehydes and Ketones	31.2	14.0	118.8
Sulfate	1.6	1.1	2.1
Particulate Soluble Organic Fraction, Percent	14.8	NA[b]	80.8

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.
[b]NA - Results not available.

TABLE F-7. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES WITH RETARDED TIMING AND TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 17-1	Test 17-2	Avg.	Test 17-1	Test 17-2	Avg.	Test 17-1	Test 17-2	Avg.
Formaldehyde	39.2	37.0	38.1	21.0	17.9	19.5	65.2	63.0	64.1
Acetaldehyde	13.0	9.2	11.1	6.2	3.6	4.9	16.5	12.8	14.7
Acrolein[a]	--	--	--	--	--	--	--	--	--
Propionaldehyde[a]	9.8*	18.0*	13.9*	2.6*	6.2*	4.4*	11.3*	27.0*	19.2*
Acetone[a]	--	--	--	--	--	--	--	--	--
Crotonaldehyde	0.6	1.6	1.1	ND	0.1	0.1	ND	1.0	0.5
Isobutyraldehyde/MEK	6.2	2.3	4.3	2.9	0.4	1.7	2.9	1.6	2.3
Benzaldehyde	4.0	2.3	3.2	ND	3.0	1.5	0.2	12.5	6.4
Hexanaldehyde	ND[b]	1.9	1.0	0.4	ND	0.2	ND	ND	ND
Total Aldehydes and Ketones	72.8	72.3	72.6	33.1	31.2	32.2	96.3	107.9	102.1
Sulfate	2.4	2.0	2.2	2.9	2.8	2.9	6.7	6.6	6.7
Particulate Soluble Organic Fraction, Percent	40.0	34.6	37.3	33.5	32.0	32.8	41.5	23.7	32.6

[a] C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.
[b] ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

TABLE F-8. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 8-1	Test 8-2	Avg.	Test 8-1	Test 8-2	Avg.	Test 8-1	Test 8-2	Avg.
Formaldehyde	28.3	28.3	28.3	14.4	15.2	14.8	55.4	47.7	51.6
Acetaldehyde	6.7	7.7	7.2	3.5	3.8	3.7	9.2	1.9	5.6
Acrolein[a]	--	--	--	--	--	--	--	--	--
Propionaldehyde[a]	4.1*	7.6*	5.9*	2.0*	2.0*	2.0*	11.6*	3.3*	7.5*
Acetone[a]	--	--	--	--	--	--	--	--	--
Crotonaldehyde	1.4	ND[b]	0.7	0.9	ND	0.5	2.5	ND	1.3
Isobutyraldehyde/MEK	3.1	0.7	1.9	1.9	1.5	1.7	10.4	3.5	7.0
Benzaldehyde	1.0	1.5	1.3	0.6	0.2	0.4	4.5	ND	2.3
Hexanaldehyde	0.7	0.3	0.5	ND	0.4	0.2	ND	ND	ND
Total Aldehydes and Ketones	45.3	46.1	45.7	23.3	23.1	23.2	93.8	56.4	75.1
Sulfate	3.6	4.3	4.0	2.4	4.7	3.6	8.0	7.3	7.7
Particulate Soluble Organic Fraction, Percent	16.3	1.4	15.4	15.3	14.2	14.8	15.6	16.2	15.9

[a]C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.
[b]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

TABLE F-9. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi, except as noted	
	FTP, with trap	FTP, without trap
	Test 19-1	Test 10-1
Formaldehyde	26.2	21.2
Acetaldehyde	5.9	5.2
Acrolein[a]	--	--
Propionaldehyde[a]	1.9	6.1*
Acetone[a]	--	--
Crotonaldehyde	0.9	3.2
Isobutyraldehyde/MEK	1.8	5.1
Benzaldehyde	0.4	2.2
Hexanaldehyde	ND[b]	2.2
Total Aldehydes and Ketones	37.1	45.2
Sulfate	1.3	2.4
Particulate Soluble Organic Fraction, Percent	37.1	13.5

[a] C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.
[b] ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

APPENDIX G

ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN

TABLE G-1. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN BASELINE WITH TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 1-1	Test 1-2	Avg	Test 1-1	Test 1-2	Avg	Test 1-1	Test 1-2	Avg
Formaldehyde	34.5	32.4	33.5	16.4	16.1	16.3	86.6	86.3	86.5
Acetaldehyde	11.1	10.1	10.6	6.0	5.0	5.5	28.3	21.2	24.8
Acrolein	ND[a]	ND	ND	ND	ND	ND	ND	ND	ND
Propionaldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	7.8	8.1	8.0	3.9	2.8	6.7	14.4	18.6	16.5
Crotonaldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isobutyraldehyde/MEK	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzaldehyde	1.0	2.1	1.6	1.0	ND	0.5	ND	2.3	1.2
Hexanaldehyde	0.5	0.5	0.5	ND	ND	ND	ND	ND	ND
Total Aldehydes and Ketones	54.9	53.2	54.1	27.3	23.9	25.6	129.3	128.4	128.9
Sulfate	1.4	1.2	1.3	1.9	1.4	1.7	6.8	4.9	5.9
Particulate Soluble Organic Fraction, Percent	43.1	48.7	45.9	46.5	49.4	48.0	24.1[b]	90.1[b]	57.1

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET, 0.1 mg/mi, NYCC, 0.5 mg/mi.
[b]Variability due in part to very small particulate and soluble organic weights for the NYCC cycle.

TABLE G-2. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN BASELINE WITHOUT TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 2-1	Test 2-2	Avg	Test 2-1	Test 2-2	Avg	Test 2-1	Test 2-2	Avg
Formaldehyde	34.5	28.2	31.4	12.3	11.7	12.0	73.9	72.8	73.4
Acetaldehyde	10.3	7.5	8.9	4.3	3.4	3.9	22.4	18.1	20.3
Acrolein	ND[a]	ND	ND	ND	ND	ND	ND	ND	ND
Propionaldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	9.0	6.4	7.7	3.7	2.3	3.0	19.9	13.2	16.6
Crotonaldehyde	0.4	ND	0.2	ND	ND	ND	ND	ND	ND
Isobutyraldehyde/MEK	ND	ND	0.2	ND	ND	ND	ND	ND	ND
Benzaldehyde	1.6	0.6	1.1	0.7	ND	0.4	ND	ND	ND
Hexanaldehyde	0.3	ND	0.2	ND	ND	ND	ND	ND	ND
Total Aldehydes and Ketones	56.1	42.7	49.4	21.0	17.4	19.2	116.2	104.1	110.2
Sulfate	3.4	3.0	3.2	2.9	2.7	2.8	7.1	28.6	17.9
Particulate Soluble Organic Fraction, Percent	22.9	22.6	22.6	23.4	21.9	22.7	19.5	19.2	19.5

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET, 0.1 mg/mi, NYCC, 0.5 mg/mi.

TABLE G-3. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi, except as noted					
	FTP, with trap			HFET, without trap		
	Test 3-1	Test 3-2	Avg.	Test 4-1	Test 4-2	Avg.
Formaldehyde	21.1	21.1	21.1	18.2	21.0	19.6
Acetaldehyde	7.4	7.2	7.3	5.6	6.9	6.3
Acrolein	ND[a]	ND	ND	ND	ND	ND
Propionaldehyde	ND	ND	ND	ND	ND	ND
Acetone	6.2	5.8	6.0	5.0	5.0	5.0
Crotonaldehyde	3.4	1.0	2.2	0.6	0.7	0.7
Isobutyraldehyde/MEK	ND	ND	ND	ND	ND	ND
Benzaldehyde	ND	ND	ND	ND	ND	ND
Hexanaldehyde	ND	ND	ND	ND	ND	ND
Total Aldehydes and Ketones	38.1	35.1	36.6	29.4	33.6	31.5
Sulfate	NA[b]	NA	NA	2.0	0.7	1.4
Particulate Soluble Organic Fraction, Percent	34.1	56.5	45.3	24.0	25.2	24.6

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.
[b]NA - Results not available.

TABLE G-4. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN LOADED TRAP (BASELINE FUEL) AND REGENERATION TESTS (BASELINE AND LOW AROMATIC FUELS)

	Emissions in mg/mi, except as noted					
	Loaded Trap NYCC Baseline Fuel	Regeneration HFET				
		Baseline Fuel		Low Aromatic Fuel		
		R-1	R-2	R-1	R-2	R-3
Formaldehyde	84.1	16.3	17.9	14.6	15.3	13.0
Acetaldehyde	22.6	6.2	6.3	6.0	8.3	5.3
Acrolein	ND[a]	ND	ND	ND	ND	ND
Propionaldehyde	ND	ND	ND	ND	ND	ND
Acetone	19.0	3.5	3.4	4.3	7.0	3.4
Crotonaldehyde	ND	ND	ND	ND	ND	0.4
Isobutyraldehyde/MEK	6.6	ND	1.2	ND	2.1	1.7
Benzaldehyde	ND	ND	ND	0.4	2.2	0.8
Hexanaldehyde	ND	ND	ND	ND	ND	0.6
Total Aldehydes and Ketones	132.3	26.0	29.8	25.3	34.9	25.2
Sulfate	11.7	3.9	NA[b]	2.2	4.3	2.3
Particulate Soluble Organic Fraction, Percent	42.4	40.0	NA[b]	38.2	31.7	28.8

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.
[b]NA - Results not available.

TABLE G-5. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN WITH FAILED INJECTORS AND TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 5-3	Test 5-2	Avg.	Test 5-1	Test 5-2	Avg.	Test 5-1	Test 5-2	Avg.
Formaldehyde	29.8	34.8	32.3	18.5	18.7	18.6	86.4	103.4	94.9
Acetaldehyde	11.0	12.2	11.6	6.6	6.0	6.3	30.6	27.5	29.1
Acrolein[a]	--	--	--	--	--	--	--	--	--
Propionaldehyde[a]	10.4*	10.4*	10.4*	4.9*	4.0*	4.5*	43.3*	32.0*	37.7*
Acetone[a]	--	--	--	--	--	--	--	--	--
Crotonaldehyde	0.3	1.7	1.0	ND[b]	ND	ND	17.8	ND	8.9
Isobutyraldehyde/MEK	4.8	6.2	5.5	2.6	ND	1.3	59.6	23.7	41.7
Benzaldehyde	1.3	1.8	1.6	1.2	0.7	1.0	19.5	5.4	12.5
Hexanaldehyde	ND	0.1	0.1	ND	0.1	0.1	12.4	ND	6.2
Total Aldehydes and Ketones	57.6	67.2	62.4	33.8	29.5	31.7	269.6	192.0	230.8
Sulfate	0.8	0.7	0.8	0.7	NA[c]	0.7	4.7	NA	4.7
Particulate Soluble Organic Fraction, Percent	67.1	72.7	69.9	54.0	76.9	65.5	~100[d]	~100[d]	~100[d]

[a] C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.
[b] ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.
[c] NA - Results not available.
[d] Values difficult to determine due to very small particulate and soluble organic weights for the NYCC cycle.

TABLE G-6. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN WITH FAILED INJECTORS AND WITHOUT TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 6-1	Test 6-2	Avg.	Test 6-1	Test 6-2	Avg.	Test 6-1	Test 6-2	Avg.
Formaldehyde	28.5	29.8	29.2	11.9	15.1	13.5	63.0	74.0	68.5
Acetaldehyde	7.3	10.7	9.0	3.0	4.8	3.9	15.2	12.2	13.7
Acrolein[a]	--	--	--	--	--	--	--	--	--
Propionaldehyde[a]	4.3*	1.1*	2.7*	1.4*	ND *	0.7*	8.1*	40.0*	24.1*
Acetone[a]	--	--	--	--	--	--	--	--	--
Crotonaldehyde	2.0	1.4	1.7	0.6	0.6	0.6	3.9	ND	2.0
Isobutyraldehyde/MEK	1.3	7.0	4.2	1.4	2.4	1.9	10.1	ND	5.1
Benzaldehyde	0.6	1.8	1.2	ND[b]	1.3	0.7	ND	1.7	0.9
Hexanaldehyde	0.6	1.1	0.9	0.2	0.6	0.4	1.2	2.2	1.7
Total Aldehydes and Ketones	44.6	52.9	48.8	18.5	24.8	21.7	101.5	130.1	115.8
Sulfate	1.7	2.5	2.1	1.6	1.6	1.6	6.8	4.1	5.5
Particulate Soluble Organic Fraction, Percent	16.8	18.4	17.6	22.2	23.7	23.0	17.8	19.0	18.4

[a] C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.
[b] ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

TABLE G-7. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN WITH RETARDED TIMING AND TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 7-1	Test 7-2	Avg.	Test 7-1	Test 7-2	Avg.	Test 7-1	Test 7-2	Avg.
Formaldehyde	41.7	38.4	40.1	18.2	19.7	19.0	109.9	97.2	103.6
Acetaldehyde	11.8	11.3	11.6	5.5	6.4	6.0	25.3	25.4	25.4
Acrolein[a]	--	--	--	--	--	--	--	--	--
Propionaldehyde[a]	9.0*	12.1*	10.6*	2.8*	5.5*	4.2*	23.3*	29.2*	26.3*
Acetone[a]	--	--	--	--	--	--	--	--	--
Crotonaldehyde	1.5	2.5	2.0	ND[b]	0.7	0.4	3.2	5.6	4.4
Isobutyraldehyde/MEK	4.2	4.6	4.4	0.6	1.1	0.9	ND	ND	ND
Benzaldehyde	1.1	1.0	1.1	0.4	0.3	0.4	ND	3.2	1.6
Hexanaldehyde	0.6	1.2	0.9	0.4	0.2	0.3	5.4	3.7	4.6
Total Aldehydes and Ketones	69.9	71.1	70.5	27.9	33.9	30.9	167.1	164.3	165.7
Sulfate	1.0	1.3	1.2	1.6	1.6	1.6	5.2	14.3	9.8
Particulate Soluble Organic Fraction, Percent	66.8	72.4	69.2	61.5	67.8	64.7	72.7	95.3	84.0

[a] C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.
[b] ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

TABLE G-8. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in mg/mi, except as noted								
	FTP			HFET			NYCC		
	Test 8-1	Test 8-2	Avg.	Test 8-1	Test 8-2	Avg.	Test 8-1	Test 8-2	Avg.
Formaldehyde									
Acetaldehyde									
Acrolein[a]									
Propionaldehyde[a]									
Acetone[a]									
Crotonaldehyde									
Isobutyraldehyde/MEK									
Benzaldehyde									
Hexanaldehyde									
Total Aldehydes and Ketones									
Sulfate	3.0	2.1	2.6	2.1	2.9	2.5	7.1	7.1	7.1
Particulate Soluble Organic Fraction, Percent	32.5	28.7	30.6	25.7	24.8	25.3	28.6	24.6	26.6

[a]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.
[b]C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.

TABLE G-9. ALDEHYDES AND KETONES, SULFATE, AND PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi, except as noted	
	FTP, with trap	FTP, without trap
	Test 9-1	Test 10-1
Formaldehyde	29.3	25.6
Acetaldehyde	10.9	8.9
Acrolein[a]	--	--
Propionaldehyde[a]	7.1*	5.9*
Acetone[a]	--	--
Crotonaldehyde	0.7	2.1
Isobutyraldehyde/MEK	2.8	ND
Benzaldehyde	3.8	ND
Hexanaldehyde	0.5	0.7
Total Aldehydes and Ketones	55.1	43.2
Sulfate	0.9	1.6
Particulate Soluble Organic Fraction, Percent	40.6	22.6

[a]C_3 aldehydes and ketones were not separated during analyses. Value marked with an asterisk is the sum of acrolein, propionaldehyde, and acetone.
[b]ND - none detected, detection limits for aldehydes and ketones and sulfate are FTP, 0.1 mg/mi; HFET 0.1 mg/min; and NYCC, 0.5 mg/mi.

APPENDIX H

GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES

TABLE H-1. GAS PHASE SEMIVOLATILE ORGANICS, LIST OF COMPOUNDS ANALYZED

POLYNUCLEAR AROMATICS

Naphthalene
2-Methylnaphthalene
Acenaphthylene
Acenaphthene[a]
Dibenzofuran
Fluorene[a]
Phenanthrene
Anthracene[a]
Fluoranthene[a]
Pyrene[a]
Benzo(a)anthracene[a]
Chrysene[a]
Benzo(b)fluoranthene[a]
Benzo(k)fluoranthene[a]
Benzo(a)pyrene[a]
Indeno(1,2,3-cd)pyrene[a]
Dibenz(a,h)anthracene[a]
Benzo(g,h,i)perylene[a]

NITRATED POLYNUCLEAR AROMATICS

9-Nitroanthracene[a]
9-Methyl-10-nitroanthracene[a,b]
7-Nitrobenz(a)anthracene[a,b]
6-Nitro-benzo(a)pyrene[a]
6-Nitrochrysene[a]
3-Nitrofluoranthrene[a]
2-Nitrofluorene[a]
1-Nitropyrene[a]
1,3-Dinitropyrene[a]
1,6-Dinitropyrene[a]
1,8-Dinitropyrene[a]

OTHER TARGET COMPOUNDS

Phenol
2-Methylphenol
3-Methylphenol[c]
4-Methylphenol
N-Nitrosodimethylamine[a]
N-nitroso-dipropylamine[a]
N-nitroso-diphenylamine[d]
Nitrobenzene[a]

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[a]Not detected in any samples during the program and therefore not listed in subsequent tables. Detection limits are 40-380 μg/mi for the FTP, 30-280 μg/mi for the HFET, and 250 to 2,400 μg/mi for the NYCC.
[b]Searched for by extracted ion chromatograph profile, no standard available.
[c]Used response factor of 4-methylphenol to quantitate.
[d]Detected in 3 Mercedes samples: Mercedes HFET cycle without trap, none detected and 550 μg/mi; Mercedes regeneration with baseline fuel, 660 and 360 μg/mi.

TABLE H-2. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES BASELINE WITH TRAP

	Emissions in μg/mi					
	FTP		HFET		NYCC	
	Test 1-3	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Naphthalene	4800	4400	2800	2200		
2-Methylnaphthalene						
Acenaphthylene						
Dibenzofuran						
Phenanthrene						
Phenol						
4-Methylphenol						
3-Methylphenol						
Minimum Detection Limit, all compounds, μg/mi	380	380	280	280	2400	2400

Blank indicates none detected.

TABLE H-3. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES BASELINE WITHOUT TRAP

	Emissions in μg/mi					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Naphthalene	2300	3200	1200	1700		4800
2-Methylnaphthalene	1100	1300	550	830		
Acenaphthylene	380	380		280		
Dibenzofuran						
Phenanthrene						
Phenol						
4-Methylphenol						
3-Methylphenol						
Minimum Detection Limit, all compounds, μg/mi	380	380	280	280	2400	2400

Blank indicates none detected.

TABLE H-4. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES BASELINE WITH REPLACEMENT TRAP

	Emissions in μg/mi FTP	
	Test 11-1	Test 11-2
Naphthalene	1400	1200
2-Methylnaphthalene	150	75
Acenaphthylene		
Dibenzofuran		
Phenanthrene		
Phenol	40	
4-Methylphenol		
3-Methylphenol		
Minimum Detection Limit, all compounds, μg/mi	40	40

Blank indicates none detected.

TABLE H-5. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL

	Emissions in μg/mi					
	FTP, with trap			FTP, without trap		
	Test 13-1	Test 13-2	Avg.	Test 4-1	Test 4-2	Avg.
Naphthalene	320	300	310	270	1200	740
2-Methylnaphthalene		40	20	130	440	290
Acenaphthylene				60		30
Dibenzofuran						
Phenanthrene		40	20			
Phenol						
4-Methylphenol						
3-Methylphenol						
Minimum Detection Limit, all compounds, μg/mi	40	40		40	40	

Blank indicates none detected.

TABLE H-6. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES LOADED TRAP AND REGENERATION TESTS (BASELINE AND LOW AROMATIC FUEL)

	Emissions, μg/mi					
	Loaded Trap NYCC Baseline Fuel	Regeneration, HFET				
		Baseline Fuel		Low Aromatic Fuel		
		R-1	R-2	R-1	R-2	R-3
Naphthalene			550	550	190	190
2-Methylnaphthalene				110		
Acenaphthylene						
Dibenzofuran				30		
Phenanthrene				55	55	30
Phenol						
4-Methylphenol						
3-Methylphenol						
Minimum Detection Limit, all compounds, μg/mi	2400	28	280	30	30	30

Blank indicates none detected.

TABLE H-7. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES WITH WORN INJECTORS AND TRAP

	Emissions in μg/mi		
	FTP Test 15-1	HFET Test 15-1	NYCC Test 15-1
Naphthalene	400	190	960
2-Methylnaphthalene	40		
Acenaphthylene			
Dibenzofuran	40		
Phenanthrene	55		
Phenol			
4-Methylphenol			
3-Methylphenol			
Minimum Detection Limit, all compounds, μg/mi	40	30	250

Blank indicates none detected.

TABLE H-8. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES WITH RETARDED TIMING AND TRAP

	Emissions in $\mu g/mi$			
	FTP		HFET	NYCC
	Test 17-1	Test 17-2	Test 17-1,2	Test 17-1,2
Naphthalene	1100	1200	550	2900
2-Methylnaphthalene	950	720	180	950
Acenaphthylene	320	290	55	
Dibenzofuran	210	190	85	
Phenanthrene	190	380	180	360
Phenol	190	130		
4-Methylphenol	60	40		
3-Methylphenol				
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40	30	250

Blank indicates none detected.

TABLE H-9. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in $\mu g/mi$			
	FTP		HFET	NYCC
	Test 8-1	Test 8-2	Test 8-1,2	Test 8-1,2
Naphthalene	340	550	550	2400
2-Methylnaphthalene	320	530	370	1400
Acenaphthylene	110	210	110	480
Dibenzofuran	60	95	55	
Phenanthrene	130	210	150	480
Phenol	60	110	70	
4-Methylphenol		60	30	
3-Methylphenol				
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40	30	250

Blank indicates none detected.

TABLE H-10. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL

	Emissions in $\mu g/mi$	
	FTP, with trap	FTP, without trap
	Test 19-1	Test 10-1
Naphthalene	290	460
2-Methylnaphthalene	60	360
Acenaphthylene		130
Dibenzofuran		40
Phenanthrene		170
Phenol		95
4-Methylphenol		
3-Methylphenol		
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40

Blank indicates none detected.

APPENDIX I

GAS PHASE SEMIVOLATILE ORGANICS, VOLKSWAGEN

TABLE I-1. GAS PHASE SEMIVOLATILE ORGANICS, LIST OF COMPOUNDS ANALYZED

POLYNUCLEAR AROMATICS

Naphthalene
2-Methylnaphthalene
Acenaphthylene
Acenaphthene[a]
Dibenzofuran
Fluorene[a]
Phenanthrene
Anthracene[a]
Fluoranthene[a]
Pyrene[a]
Benzo(a)anthracene[a]
Chrysene[a]
Benzo(b)fluoranthene[a]
Benzo(k)fluoranthene[a]
Benzo(a)pyrene[a]
Indeno(1,2,3-cd)pyrene[a]
Dibenz(a,h)anthracene[a]
Benzo(g,h,i)perylene[a]

NITRATED POLYNUCLEAR AROMATICS

9-Nitroanthracene[a]
9-Methyl-10-nitroanthracene[a,b]
7-Nitrobenz(a)anthracene[a,b]
6-Nitro-benzo(a)pyrene[a]
6-Nitrochrysene[a]
3-Nitrofluoranthrene[a]
2-Nitrofluorene[a]
1-Nitropyrene[a]
1,3-Dinitropyrene[a]
1,6-Dinitropyrene[a]
1,8-Dinitropyrene[a]

OTHER TARGET COMPOUNDS

Phenol
2-Methylphenol
3-Methylphenol[c]
4-Methylphenol
N-Nitrosodimethylamine[a]
N-nitroso-dipropylamine[a]
N-nitroso-diphenylamine[d]
Nitrobenzene[a]

[a]Not detected in any samples during the program and therefore not listed in subsequent tables. Detection limits are 40-80 μg/mi for the FTP, 30-60 μg/mi for the HFET, and 250 to 480 μg/mi for the NYCC.
[b]Searched for by extracted ion chromatograph profile, no standard available.
[c]Used response factor of 4-methylphenol to quantitate.
[d]Detected in 6 Volkswagen samples: Volkswagen baseline with trap, 390 μg/mi and not detected for HFET; and Volkswagen baseline without trap, 1,000 and 420 μg/mi for FTP, not detected and 470 μg/mi for HFET, and 2,900 and 6,200 μg/mi for NYCC.

TABLE I-2. GAS PHASE VOLATILE ORGANICS, VOLKSWAGEN BASELINE WITH TRAP

	Emissions in $\mu g/mi$					
	FTP		HFET		NYCC	
	Test 1-1	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Naphthalene	1300	1200	610	440	3100	2900
2-Methylnaphthalene	930	360	330	190		1700
Acenaphthylene						
Dibenzofuran						
Phenanthrene						
Phenol						
4-Methylphenol						
3-Methylphenol						
Minimum Detection Limit, all compounds, $\mu g/mi$	80	80	60	60	480	480

Blank indicates none detected.

TABLE I-3. GAS PHASE SEMIVOLATILE ORGANICS, MERCEDES BASELINE WITHOUT TRAP

	Emissions in $\mu g/mi$					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Naphthalene	1140	1250	660	550	2900	4300
2-Methylnaphthalene	760	870	410	300	1400	2200
Acenaphthylene		130				
Dibenzofuran						
Phenanthrene		110				
Phenol						
4-Methylphenol						
3-Methylphenol						
Minimum Detection Limit, all compounds, $\mu g/mi$	80	80	60	60	480	480

Blank indicates none detected.

TABLE I-4. GAS PHASE VOLATILE ORGANICS, VOLKSWAGEN WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL

	Emissions in $\mu g/mi$					
	FTP, with trap			FTP, without trap		
	Test 3-1	Test 3-2	Avg.	Test 4-1	Test 4-2	Avg.
Naphthalene	760	760	760	760	950	860
2-Methylnaphthalene	380	380	380	380	760	570
Acenaphthylene						
Dibenzofuran						
Phenanthrene						
Phenol						
4-Methylphenol						
3-Methylphenol						
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40		40	40	

Blank indicates none detected.

TABLE I-5. GAS PHASE SEMIVOLATILE ORGANICS, VOLKSWAGEN LOADED TRAP AND REGENERATION TESTS, BASELINE AND LOW AROMATIC FUELS

	Emissions in $\mu g/mi$				
	Loaded Trap	Regeneration, HFET			
	NYCC	Baseline Fuel		Low Aromatic Fuel	
	Baseline Fuel	R-1	R-3	R-1	R-2
Naphthalene	3600	165	550	470	330
2-Methylnaphthalene	2200	85	280	190	140
Acenaphthylene					
Dibenzofuran				30	
Phenanthrene			85	140	85
Phenol					
4-Methylphenol					
3-Methylphenol					
Minimum Detection Limit, all compounds, $\mu g/mi$	480	60	60	30	30

Blank indicates none detected.

TABLE I-6. GAS PHASE SEMIVOLATILE ORGANICS, VOLKSWAGEN WITH FAILED INJEJCTORS AND TRAP

	Emissions in $\mu g/mi$			
	FTP		HFET	NYCC
	Test 5-1	Test 5-2	Test 5-1,2	Test 5-1,2
Naphthalene	610	650	350	1400
2-Methylnaphthalene	650	550	180	600
Acenaphthylene	75	75		
Dibenzofuran	55	55		
Phenanthrene	150	150	85	
Phenol	75	75		
4-Methylphenol				
3-Methylphenol				
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40	30	250

Blank indicates none detected.

TABLE I-7. GAS PHASE SEMIVOLATILE ORGANICS, VOLKSWAGEN WITH FAILED INJEJCTORS AND WITHOUT TRAP

	Emissions in $\mu g/mi$			
	FTP		HFET	NYCC
	Test 6-1	Test 6-2	Test 6-1,2	Test 6-1,2
Naphthalene	530	490	370	1900
2-Methylnaphthalene	610	550	320	1300
Acenaphthylene	170	170	85	360
Dibenzofuran	60	60	30	
Phenanthrene	210	150	95	240
Phenol	95	110	55	
4-Methylphenol	60	60		
3-Methylphenol				
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40	30	250

Blank indicates none detected.

TABLE I-8. GAS PHASE SEMIVOLATILE ORGANICS, VOLKSWAGEN WITH RETARDED TIMING AND TRAP

	Emissions in $\mu g/mi$			
	FTP		HFET	NYCC
	Test 7-1	Test 7-2	Test 7-1,2	Test 7-1,2
Naphthalene	610	680	470	2900
2-Methylnaphthalene	820	950	350	2500
Acenaphthylene	190	170	70	360
Dibenzofuran	95	95	40	
Phenanthrene	250	250	120	480
Phenol	150	190	40	360
4-Methylphenol	130	110		1100
3-Methylphenol	55	40		
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40	30	250

Blank indicates none detected

TABLE I-9. GAS PHASE SEMIVOLATILE ORGANICS, VOLKSWAGEN WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in $\mu g/mi$			
	FTP		HFET	NYCC
	Test 8-1	Test 8-2	Test 8-1,2	Test 8-1,2
Naphthalene	740	720	470	2400
2-Methylnaphthalene	970	930	440	2200
Acenaphthylene	230	230	95	360
Dibenzofuran	95	110	40	
Phenanthrene	250	270	140	480
Phenol	210	250	85	480
4-Methylphenol	150	170	40	240
3-Methylphenol	57	76		
Minimum Detection Limit, all compounds, $\mu g/mi$	40	40	30	250

Blank indicates none detected

TABLE I-10. GAS PHASE SEMIVOLATILE ORGANICS, VOLKSWAGEN WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL

	Emissions in μg/mi	
	FTP, with trap Test 9-1	FTP, without trap Test 10-1
Naphthalene	460	630
2-Methylnaphthalene	610	890
Acenaphthylene	95	210
Dibenzofuran	60	75
Phenanthrene	170	290
Phenol	95	150
4-Methylphenol		95
3-Methylphenol		
Minimum Detection Limit, all compounds, μg/mi	40	40

Blank indicates none detected

APPENDIX J

PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, MERCEDES

TABLE J-1. PARTICULATE ASSOCIATED SEMIVOLATIVE ORGANICS, LIST OF COMPOUNDS ANALYZED

POLYNUCLEAR AROMATICS

Naphthalene
2-Methylnaphthalene
Acenaphthylene
Acenaphthene[a]
Dibenzofuran
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene[a]
Benzo(g,h,i)perylene

NITRATED POLYNUCLEAR AROMATICS

9-Nitroanthracene[a]
9-Methyl-10-nitroanthracene[a,b]
7-Nitrobenz(a)anthracene[a,b]
6-Nitro-benzo(a)pyrene[a]
6-Nitrochrysene[a]
3-Nitrofluoranthrene[a]
2-Nitrofluorene[a]
1-Nitropyrene[a]
1,3-Dinitropyrene[a]
1,6-Dinitropyrene[a]
1,8-Dinitropyrene[a]

OTHER TARGET COMPOUNDS

Phenol[a]
2-Methylphenol[a]
3-Methylphenol[a,c]
4-Methylphenol[a]
N-Nitrosodimethylamine[a]
N-nitroso-dipropylamine[a]
N-nitroso-diphenylamine[a]
Nitrobenzene[a]

[a]Not detected in any samples during the program and therefore not listed in subsequent tables. Detection limits are < 0.6 μg/mi for the FTP, < 0.4 μg/mi for HFET, and < 3.8 μg/mi for the NYCC in the Mercedes baseline with trap and < 1.1 μg/mi for the FTP, < 0.8 μg/mi for the HFET, and < 6.7 μg/mi for the NYCC is all other tests.
[b]Searched for by extracted ion chromatogram profile, no standard available.
[c]Used response factor of 4-methylphenol to quantitate.

TABLE J-2. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, MERCEDES BASELINE WITH TRAP

	Emissions, $\mu g/mi$					
	FTP		HFET		NYCC	
	Test 1-3	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Naphthalene	ND[a]	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Dibenzofuran	0.5	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND
Phenanthrene	5.6	8.1	2.6	2.4	19.7	21.7
Anthracene	ND	ND	ND	ND	ND	ND
Fluoranthene	16.4	14.2	7.9	8.0	23.6	28.9
Pyrene	9.8	12.4	6.2	8.0	27.6	28.9
Benzo(a)anthracene	ND	0.6	0.9	ND	ND	ND
Chrysene	2.8	1.7	3.1	0.8	ND	7.2
Benzofluoranthene	1.5	2.0	2.2	2.4	ND	ND
Benzo(a)pyrene	1.1	1.3	1.8	1.6	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND

[a]ND - none detected, <0.6 $\mu g/mi$ FTP, <0.4 $\mu g/mi$ HFET, <3.8 $\mu g/mi$ NYCC

TABLE J-3. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, MERCEDES BASELINE WITHOUT TRAP

	Emissions, µg/mi					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Naphthalene	ND[a]	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND
Phenanthrene	104.3	111.4	39.5	38.0	196.2	181.3
Anthracene	6.9	4.9	ND	ND	20.3	13.5
Fluoranthene	46.2	53.8	36.4	38.8	88.0	74.2
Pyrene	62.8	70.0	45.7	46.7	128.6	94.4
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND
Chrysene	6.5	5.0	4.7	4.8	13.5	ND
Benzofluoranthene	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND

[a]ND - none detected, <1.1 µg/mi FTP, <0.8 µg/mi HFET, <6.7 µg/mi NYCC.

TABLE J-4. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, MERCEDES LOADED TRAP AND REGENERATION, BASELINE FUEL

	Emissions, μg/mi		
	Loaded Trap	Regeneration, HFET	
	NYCC	R-1	R-2
Naphthalene	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND
Acenaphthylene	ND	ND	ND
Dibenzofuran	ND	0.9	0.8
Fluorene	ND	ND	ND
Phenanthrene	33.8	7.3	6.7
Anthracene	ND	ND	ND
Fluoranthene	11.7	5.7	2.8
Pyrene	9.0	5.3	2.5
Benzo(a)anthracene	ND	ND	ND
Chrysene	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND

[a]ND - none detected, <1.1 μg/mi FTP, <0.8 μg/mi HFET, <6.7 μg/mi NYCC.

TABLE J-5. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, MERCEDES WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL

	Emissions in μg/mi		
	FTP, with trap	FTP, without trap	
	Test 13-1,2	Test 4-1	Test 4-2
Naphthalene	ND	0.6	0.5
2-Methylnaphthalene	ND	0.5	ND
Acenaphthylene	ND	0.7	ND
Dibenzofuran	ND	1.7	1.3
Fluorene	ND	1.8	1.4
Phenanthrene	5.9	139	118
Anthracene	ND	ND	ND
Fluoranthene	4.3	34.7	31.2
Pyrene	2.2	43.6	45.7
Benzo(a)anthracene	ND	ND	0.6
Chrysene	ND	4.1	4.2
Benzo(b)fluoranthene	ND	1.8	0.6
Benzo(k)fluoranthene	ND	ND	ND
Benzo(a)pyrene	ND	1.6	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND

[a]ND - none detected, <1.1 μg/mi FTP, <0.8 μg/mi HFET, <6.7 μg/mi NYCC.

TABLE J-6. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, MERCEDES WITH RETARDED TIMING AND WITH AND WITHOUT TRAP, FTP TESTS

	Emissions in $\mu g/mi$	
	FTP, with trap	FTP, without trap
	Test 17-2	Test 8-2
Naphthalene	ND	ND
2-Methylnaphthalene	ND	ND
Acenaphthylene	ND	ND
Dibenzofuran	ND	ND
Fluorene	ND	ND
Phenanthrene	3.8	25.8
Anthracene	ND	ND
Fluoranthene	7.5	46.2
Pyrene	10.2	39.3
Benzo(a)anthracene	1.6	7.5
Chrysene	5.4	10.8
Benzo(b)fluoranthene	4.3	9.7
Benzo(k)fluoranthene	1.1	ND
Benzo(a)pyrene	2.7	2.7
Indeno(1,2,3-cd)pyrene	ND	ND
Benzo(g,h,i)perylene	ND	ND

[a]ND - none detected, <1.1 $\mu g/mi$ FTP, <0.8 $\mu g/mi$ HFET, <6.7 $\mu g/mi$ NYCC.

APPENDIX K

PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, VOLKSWAGEN

TABLE K-1. PARTICULATE ASSOCIATED SEMIVOLATIVE ORGANICS, LIST OF COMPOUNDS ANALYZED

POLYNUCLEAR AROMATICS

Naphthalene
2-Methylnaphthalene
Acenaphthylene
Acenaphthene[a]
Dibenzofuran
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene[a]
Benzo(g,h,i)perylene

NITRATED POLYNUCLEAR AROMATICS

9-Nitroanthracene[a]
9-Methyl-10-nitroanthracene[a,b]
7-Nitrobenz(a)anthracene[a,b]
6-Nitro-benzo(a)pyrene[a]
6-Nitrochrysene[a]
3-Nitrofluoranthrene[a]
2-Nitrofluorene[a]
1-Nitropyrene[a]
1,3-Dinitropyrene[a]
1,6-Dinitropyrene[a]
1,8-Dinitropyrene[a]

OTHER TARGET COMPOUNDS

Phenol[a]
2-Methylphenol[a]
3-Methylphenol[a,c]
4-Methylphenol[a]
N-Nitrosodimethylamine[a]
N-nitroso-dipropylamine[a]
N-nitroso-diphenylamine[a]
Nitrobenzene[a]

[a]Not detected in any samples during the program and therefore not listed in subsequent tables. Detection limits are <1.1 μg/mi for the FTP, <0.8 μg/mi for HFET, and <6.7 μg/mi for the NYCC.
[b]Searched for by extracted ion chromatogram profile, no standard available.
[c]Used response factor of 4-methylphenol to quantitate.

TABLE K-2. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, VOLKSWAGEN BASELINE WITH TRAP

	Emissions, μg/mi					
	FTP		HFET		NYCC	
	Test 1-1	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Naphthalene	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND
Phenanthrene	0.6	ND	0.9	ND	6.9	ND
Anthracene	ND	ND	ND	ND	ND	ND
Fluoranthene	2.1	0.7	1.5	ND	ND	ND
Pyrene	6.4	2.8	3.4	1.1	9.7	ND
Benzo(a)anthracene	1.6	ND	1.5	ND	ND	ND
Chrysene	3.5	1.8	3.7	3.2	ND	ND
Benzo(b)fluoranthene	1.9	ND	2.0	1.0	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND

[a]ND - none detected, <1.1 μg/mi FTP, <0.8 μg/mi HFET, <6.7 μg/mi NYCC.

TABLE K-3. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, VOLKSWAGEN BASELINE WITHOUT TRAP

	Emissions, μg/mi					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Naphthalene	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND
Phenanthrene	10.2	12.8	3.8	4.0	18.6	20.0
Anthracene	ND	ND	ND	ND	ND	ND
Fluoranthene	18.7	21.9	10.1	9.4	51.1	44.9
Pyrene	46.6	49.6	21.8	22.6	96.6	82.8
Benzo(a)anthracene	4.7	4.5	3.1	3.4	9.7	7.6
Chrysene	ND	6.9	ND	5.6	12.4	9.7
Benzo(b)fluoranthene	3.8	5.2	4.3	4.7	17.3	11.7
Benzo(k)fluoranthene	ND	ND	ND	ND	10.4	ND
Benzo(a)pyrene	3.5	3.0	1.5	3.3	ND	8.3
Indeno(11,2,3-cd)pyrene	ND	0.8	0.9	1.0	ND	ND
Benzo(g,h,i)perylene	2.4	2.6	1.8	2.1	13.8	11.0

[a]ND - none detected, <1.1 μg/mi FTP, <0.8 μg/mi HFET, <6.7 μg/mi NYCC.

TABLE K-4. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, VOLKSWAGEN REGENERATION, HFET

	Emissions in μg/mi
	R-2
Naphthalene	ND
2-Methylnaphthalene	ND
Acenaphthylene	ND
Dibenzofuran	ND
Fluorene	ND
Phenanthrene	ND
Anthracene	ND
Fluoranthene	1.6
Pyrene	2.3
Benzo(a)anthracene	2.3
Chrysene	5.5
Benzo(b)fluoranthene	4.7
Benzo(k)fluoranthene	ND
Benzo(a)pyrene	3.9
Indeno(1,2,3-cd)pyrene	ND
Benzo(g,h,i)perylene	ND

[a]ND - none detected, <1.1 μg/mi FTP, <0.8 μg/mi HFET, <6.7 μg/mi NYCC.

TABLE K-5. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, VOLKSWAGEN WITH AND WITHOUT TRAP AND LOW AROMATIC FUEL

	Emissions in $\mu g/mi$	
	FTP, with trap	FTP, without trap
	Test 3-2	Test 4-2
Naphthalene	ND	ND
2-Methylnaphthalene	ND	ND
Acenaphthylene	ND	ND
Dibenzofuran	ND	ND
Fluorene	ND	ND
Phenanthrene	ND	11.9
Anthracene	ND	ND
Fluoranthene	ND	20.0
Pyrene	ND	20.0
Benzo(a)anthracene	ND	2.2
Chrysene	ND	3.2
Benzo(b)fluoranthene	ND	2.7
Benzo(k)fluoranthene	ND	ND
Benzo(a)pyrene	ND	2.2
Indeno(1,2,3-cd)pyrene	ND	ND
Benzo(g,h,i)perylene	ND	ND

[a]ND - none detected, <1.1 $\mu g/mi$ FTP, <0.8 $\mu g/mi$ HFET, <6.7 $\mu g/mi$ NYCC.

TABLE K-6. PARTICULATE ASSOCIATED SEMIVOLATILE ORGANICS, VOLKSWAGEN WITH RETARDED TIMING AND WITH AND WITHOUT TRAP, FTP TESTS

	Emissions in μg/mi	
	FTP, with trap	FTP, without trap
	Test 7-2	Test 8-2
Naphthalene	ND	ND
2-Methylnaphthalene	ND	ND
Acenaphthylene	ND	ND
Dibenzofuran	ND	ND
Fluorene	ND	ND
Phenanthrene	2.2	17.2
Anthracene	ND	ND
Fluoranthene	4.3	31.7
Pyrene	8.1	9.7
Benzo(a)anthracene	2.7	12.4
Chrysene	3.8	15.1
Benzo(b)fluoranthene	2.2	19.4
Benzo(k)fluoranthene	ND	ND
Benzo(a)pyrene	ND	6.5
Indeno(1,2,3-cd)pyrene	ND	ND
Benzo(g,h,i)perylene	ND	8.6

[a]ND - none detected, <1.1 μg/mi FTP, <0.8 μg/mi HFET, <6.7 μg/mi NYCC.

APPENDIX L

1,3-BUTADIENE, MERCEDES AND VOLKSWAGEN

TABLE L-1. 1,3-BUTADIENE, MERCEDES BASELINE WITHOUT TRAP, FTP TESTS

	FTP Emissions in mg/mi, except as noted		
	With trap	Without Trap	
	Test 11-4	Test 2-4	Test 2-5
Total Hydrocarbons	270	230	190
1,3 Butadiene	3.6	3.4	3.7
1,3-Butadiene Percent of Total hydrocarbons	1.3	1.5	1.9
Other C_4 Hydrocarbons			
Isobutylene	1.0	0.4	1.0
1-Butene	2.5	2.3	2.7
Detection Limits for 1,3-Butadiene	0.5	0.5	0.5

TABLE L-2. 1,3-BUTADIENE, MERCEDES WITH RETARDED TIMING, WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL, FTP TESTS

	FTP Emissions in mg/mi, except as noted	
	With Trap	Without Trap
	Test 19-1	Test 10-1
Total Hydrocarbons	250	260
1,3 Butadiene	7.7	5.9
1,3-Butadiene Percent of Total Hydrocarbons	3.1	2.3
Other C_4 Hydrocarbons		
Isobutylene	1.4	1.2
1-Butene	4.5	3.5
Detection Limits for 1,3-Butadiene	0.5	0.5

TABLE L-3. 1,3-BUTADIENE, VOLKSWAGEN BASELINE WITH AND WITHOUT TRAP, FTP TESTS

	FTP Emissions in mg/mi, except as noted			
	With trap		Without trap	
	Test 1-5	Test 1-7	Test 2-4	Test 2-6
Total Hydrocarbons	140	200	300	290
1,3-Butadiene	1.5	4.5	4.4	4.3
1,3 Butadiene Percent of Total Hydrocarbons	1.1	2.3	1.5	1.5
Other C_4 Hydrocarbons				
Isobutylene	0.6	1.2	1.1	1.5
1-Butene	2.1	2.6	3.0	3.4
Detection Limits for 1,3 Butadiene	0.5	0.5	0.5	0.5

TABLE L-4. 1,3-BUTADIENE, VOLKSWAGEN WITH FAILED INJECTORS AND WITH AND WITHOUT TRAP; FTP, HFET, AND NYCC TESTS

	Emissions in mg/mi, except as noted					
	FTP		HFET		NYCC	
	With Trap[a]	Without Trap	With Trap	Without Trap	With Trap	Without Trap
	Test 5-2,3	Test 6-2	Test 5-1	Test 6-2	Test 5-1	Test 6-2
Total Hydrocarbons	250	360	100	150	410	560
1,3-Butadiene	4.9	7.6	2.1	1.4	11.7	ND[b]
1,3 Butadiene Percent of Total Hydrocarbons	2.0	2.1	2.1	0.9	2.9	<0.3
Other C_4 Hydrocarbons						
Isobutylene	1.6	1.6	ND[c]	0.7	ND	ND
1-Butene	3.7	2.3	1.4	1.6	7.5	6.9
Detection Limits for 1,3 Butadiene	0.5	0.5	0.2	0.2	1.7	1.7

[a]Average of two tests.
[b]NA - not available.
[c]ND - none detected.

TABLE L-5. 1,3-BUTADIENE, VOLKSWAGEN WITH RETARDED TIMING AND WITH AND WITHOUT TRAP; FTP, HFET, AND NYCC TESTS

	Emissions in mg/mi, except as noted					
	FTP		HFET		NYCC	
	With Trap Test 7-2	Without Trap[a] Test 8-1,2	With Trap Test 7-2	Without Trap[a] Test 8-1,2	With Trap Test	Without Trap[a] Test 8-1,2
Total Hydrocarbons	560	620	180	220	--	1490
1,3-Butadiene	9.1	10.2	4.8	3.5	NA[b]	23.6
1,3 Butadiene Percent of Total Hydrocarbons	1.6	1.6	2.7	1.6	--	1.6
Other C_4 Hydrocarbons						
Isobutylene	2.6	2.3	1.0	1.0	--	6.1
1-Butene	6.9	6.5	2.5	2.4	--	15.5
Detection Limits for 1,3 Butadiene	0.5	0.5	0.2	0.2	0.2	1.7

[a]Average of two tests.
[b]NA - not available.

APPENDIX M

GASEOUS VOLATILE ORGANICS, MERCEDES

TABLE M-1. GASEOUS VOLATILE ORGANICS, LIST OF COMPOUNDS ANALYZED

INITIAL ANALYSES ONLY

Methylene chloride
Acetone
Carbon disulfide
1,1-Dichloroethene
1,1-Dichloroethane
trans-1,2-Dichloroethene
1,2-Dichloroethane
Acrolein
Acrylonitrile
2-Butanone
1,1,1-Trichloroethane
Carbon tetrachloride
Vinyl acetate
Bromodichloromethane
1,2-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
cis-1,3-Dichloropropene
2-Chloroethyl vinyl ether
Bromoform
2-Hexanone
4-Methyl-2-pentanone
Tetrachloroethene
Chlorobenzene
Ethylbenzene
Styrene

ALL ANALYSES

Benzene
Toluene
Total Xylenes
1,3-Butadiene
Chloroform
1,4-Dioxane
Phosgene

TABLE M-2. GASEOUS VOLATILE ORGANICS, MERCEDES BASELINE WITH TRAP

	Emissions, mg/mi					
	FTP		HFET		NYCC	
	Test 1-3	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Methylene chloride	1.1	ND[a]	ND	ND	ND	ND
Acetone	0.4	1.0	0.3	0.3	7.0	2.5
Carbon disulfide	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND
Acrolein	0.1	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND
2-Butanone	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	*[b]	*	*	*	*	*
Carbon Tetrachloride	**[c]	**	ND	ND	ND	ND
Vinyl acetate	ND	0.1	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
2-Chloroethyl vinyl ether	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND
2-Hexanone	0.1	0.1	ND	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.5	0.2	0.2	0.3	ND	1.4
Styrene	0.2	0.2	0.1	0.1	ND	0.6
Tetrahydrofuran	ND	ND	ND	ND	ND	ND
Benzene	ND	5.3	8.3	0.8	2.7	3.3
Toluene	NA[e]	3.4	NA	NA	4.8	3.0
Total Xylenes	2.0	0.9	0.4	0.9	ND	5.3
1,3-Butadiene[d]	ND	ND	ND	ND	ND	ND
Chloroform[d]	ND	ND	ND	ND	ND	ND
1,4-Dioxane[d]	ND	ND	ND	ND	ND	ND
Phosgene[d]	ND	ND	ND	ND	ND	ND

[a]ND-none detected, detection limits are <0.1 mg/mi FTP, <0.1 mg/mi HFET,<0.5 mg/mi NYCC.
[b]*-Found on Blank Pallflex Filters.
[c]**-Higher levels of 1,1,1-Trichloroethane interfered with analysis of carbon tetrachloride.
[d]Detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.
[e]NA-Results not available.

TABLE M-3. GASEOUS VOLATILE ORGANICS, MERCEDES BASELINE WITHOUT TRAP

	Emissions, mg/mi					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Methylene chloride	0.2	0.1	0.2	0.2	1.2	ND
Acetone[a]	*	*	*	*	*	*
Carbon disulfide	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND
Acrolein	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND
2-Butanone	0.4	0.2	0.1	0.1	0.9	1.7
1,1,1-Trichloroethane[a]	*	*	*	*	*	*
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND
Vinyl acetate	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
2-Chloroethyl vinyl ether	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	0.4	ND	0.2	1.6	2.4
4-Methyl-2-pentanone	0.3	0.4	0.2	0.4	1.6	2.1
Tetrachloroethene	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.8	0.5	0.1	0.3	1.9	2.2
Styrene	0.8	0.3	ND	ND	1.5	1.5
Benzene	9.8	4.5	0.3	0.8	20.6	18.5
Toluene	15.7	12.8	3.0	8.3	38.0	44.9
Total Xylenes	3.1	2.5	0.6	2.2	8.5	12.1
1,3-Butadiene[c]	ND	ND	ND	ND	ND	ND
Chloroform[c]	ND	ND	ND	ND	ND	ND
1,4-Dioxane[c]	ND	ND	ND	ND	ND	ND
Phosgene[c]	ND	ND	ND	ND	ND	ND

[a] *-Found on blank filter and/or in background sample.
[b] ND-None detected - Detection limits are <0.1 mg/mi FTP, <0.1 mg/mi HFET, and <0.5 mg/mi NYCC.
[c] Detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, and <1.1 mg/mi NYCC.

TABLE M-4. GASEOUS VOLATILE ORGANICS, MERCEDES LOADED TRAP AND REGENERATION TESTS, BASELINE AND LOW AROMATIC FUELS

	Emissions in mg/mi					
	Loaded Trap NYCC Baseline Fuel	Regeneration, HFET				
		Baseline Fuel		Low Aromatic Fuel		
		R-1	R-2	R-1	R-2	R-3
Benzene	3.6	NA[b]	11.3	4.2	3.6	3.1
Toluene	1.2	NA	20.9	1.0	1.0	0.1
Total Xylenes	1.1	NA	2.0	0.2	ND	0.1
1,3-Butadiene	ND[a]	NA	ND	ND	ND	ND
Chloroform	ND	NA	ND	ND	ND	ND
1,4-Dioxane	ND	NA	ND	ND	ND	ND
Phosgene	ND	NA	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.
[b]NA-Data not available.

TABLE M-5. GASEOUS VOLATILE ORGANICS, MERCEDES WITH WORN INJECTORS AND TRAP

	Emissions in mg/mi		
	FTP	HFET	NYCC
	Test 15-1	Test 15-1	Test 15-1
Benzene	13.5	5.6	26.4
Toluene	5.1	1.4	13.2
Total Xylenes	1.4	0.3	13.2
1,3-Butadiene	ND[a]	ND	ND
Chloroform	ND	ND	ND
1,4-Dioxane	ND	ND	ND
Phosgene	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.

TABLE M-6. GASEOUS VOLATILE ORGANICS, MERCEDES BASELINE WITH REPLACEMENT TRAP

	Emissions in mg/mi	
	FTP	
	Test 11-1	Test 11-2
Benzene	15.0	12.7
Toluene	6.1	6.5
Total Xylenes	1.7	1.2
1,3-Butadiene	ND[a]	ND
Chloroform	ND	ND
1,4-Dioxane	ND	ND
Phosgene	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.

TABLE M-7. GASEOUS VOLATILE ORGANICS, MERCEDES WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi			
	FTP, with trap		FTP, without trap	
	Test 13-1	Test 13-2	Test 4-1	Test 4-2
Benzene	5.8	5.2	4.5	8.4
Toluene	1.0	2.0	5.7	9.1
Total Xylenes	ND[a]	0.4	2.5	4.0
1,3-Butadiene	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are < 0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC

TABLE M-8. GASEOUS VOLATILE ORGANICS, MERCEDES WITH RETARDED TIMING AND TRAP

	Emissions in mg/mi			
	FTP		HFET	NYCC
	Test 17-1	Test 17-2	Test 17-1,-2	Test 17-1,-2
Benzene	12.1	13.9	6.5	24.3
Toluene	5.2	5.3	1.9	13.7
Total Xylenes	2.0	1.9	0.4	6.1
1,3-Butadiene	ND[a]	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <0.5 mg/mi NYCC.

TABLE M-9. GASEOUS VOLATILE ORGANICS, MERCEDES WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in mg/mi			
	FTP		HFET	NYCC
	Test 8-1	Test 8-2	Test 8-1,-2	Test 8-1,-2
Benzene	5.9	6.3	3.9	14.8
Toluene	3.0	3.8	1.9	8.9
Total Xylenes	1.1	1.5	0.7	2.9
1,3-Butadiene	ND[a]	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <0.5 mg/mi NYCC.

TABLE M-10. GASEOUS VOLATILE ORGANICS, MERCEDES WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi	
	FTP, with trap	FTP, without trap
	Test 19-1	Test 10-1
Benzene	12.0	7.8
Toluene	4.2	5.8
Total Xylenes	1.2	1.6
1,3-Butadiene	ND[a]	ND
Chloroform	ND	ND
1,4-Dioxane	ND	ND
Phosgene	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.

APPENDIX N

GASEOUS VOLATILE ORGANICS, VOLKSWAGEN

TABLE N-1. GASEOUS VOLATILE ORGANICS, LIST OF COMPOUNDS ANALYZED

COMPOUNDS ALL ANALYSES

Benzene
Toluene
Total Xylenes
1,3-Butadiene
Chloroform
1,4-Dioxane
Phosgene

TABLE N-2. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN BASELINE WITH TRAP

	Emissions, mg/mi					
	FTP		HFET		NYCC	
	Test 1-1	Test 1-2	Test 1-1	Test 1-2	Test 1-1	Test 1-2
Benzene	7.3	7.5	3.5	3.3	19.5	16.4
Toluene	8.2	6.6	2.7	2.6	19.5	16.9
Total Xylenes	5.3	4.9	2.1	1.3	14.8	14.8
1,3-Butadiene	ND[a]	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.

TABLE N-3. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN BASELINE WITHOUT TRAP

	Emissions, mg/mi					
	FTP		HFET		NYCC	
	Test 2-1	Test 2-2	Test 2-1	Test 2-2	Test 2-1	Test 2-2
Benzene	4.9	6.3	2.8	2.8	17.4	2.9
Toluene	5.4	7.5	2.4	3.6	16.9	4.9
Total Xylenes	3.4	4.2	1.8	2.1	11.6	ND
1,3-Butadiene	ND[a]	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.

TABLE N-4. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN WITH AND WITHOUT TRAP AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi			
	FTP, with trap		FTP, without trap	
	Test 3-1	Test 3-2	Test 4-1	Test 4-2
Benzene	0.8	2.9	ND	0.3
Toluene	7.1	4.1	1.9	2.2
Total Xylenes	8.6	4.2	0.5	0.7
1,3-Butadiene	ND[a]	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.

TABLE N-5. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN LOADED TRAP AND REGENERATION TESTS, BASELINE AND LOW AROMATIC FUELS

	Emissions in mg/mi					
	Loaded Trap NYCC Baseline Fuel	Regeneration, HFET				
		Baseline Fuel			Low Aromatic Fuel	
		R-1	R-2	R-3	R-1	R-2
Benzene	15.3	1.2	NA[b]	2.8	4.8	2.3
Toluene	10.6	1.9	NA	2.1	2.6	1.6
Total Xylenes	ND[a]	NA	NA	0.7	0.4	0.6
1,3-Butadiene	ND	ND	NA	ND	ND	ND
Chloroform	ND	ND	NA	ND	ND	ND
1,4-Dioxane	ND	ND	NA	ND	ND	ND
Phosgene	ND	ND	NA	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.
[b]NA-Data not available.

TABLE N-6. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN WITH FAILED INJECTORS AND TRAP

	Emissions in mg/mi			
	FTP		HFET	NYCC
	Test 5-3	Test 5-2	Test 5-1,-2	Test 5-1,-2
Benzene	6.0	6.0	2.9	15.8
Toluene	4.3	4.1	1.9	14.3
Total Xylenes	1.4	2.0	0.4	4.0
1,3-Butadiene	ND[a]	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <0.5 mg/mi NYCC.

TABLE N-7. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN WITH FAILED INJECTORS AND WITHOUT TRAP

	Emissions in mg/mi			
	FTP		HFET	NYCC
	Test 6-1	Test 6-2	Test 6-1,-2	Test 6-1,-2
Benzene	5.5	5.6	2.2	11.6
Toluene	4.2	8.0	2.0	12.7
Total Xylenes	1.0	2.0	0.5	3.4
1,3-Butadiene	ND[a]	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <0.5 mg/mi NYCC.

TABLE N-8. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN WITH RETARDED TIMING AND WITH TRAP

	Emissions in mg/mi			
	FTP		HFET	NYCC
	Test 7-1	Test 7-2	Test 7-1,-2	Test 7-1,-2
Benzene	7.7	8.6	4.1	17.7
Toluene	5.7	6.7	2.6	15.3
Total Xylenes	2.4	3.1	1.1	7.1
1,3-Butadiene	ND[a]	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <0.5 mg/mi NYCC.

TABLE N-9. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN WITH RETARDED TIMING AND WITHOUT TRAP

	Emissions in mg/mi			
	FTP		HFET	NYCC
	Test 8-1	Test 8-2	Test 8-1,-2	Test 8-1,-2
Benzene	9.0	7.8	3.0	20.6
Toluene	5.2	4.6	1.9	14.5
Total Xylenes	2.7	2.1	0.9	6.6
1,3-Butadiene	ND[a]	ND	ND	ND
Chloroform	ND	ND	ND	ND
1,4-Dioxane	ND	ND	ND	ND
Phosgene	ND	ND	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <0.5 mg/mi NYCC.

TABLE N-10. GASEOUS VOLATILE ORGANICS, VOLKSWAGEN WITH RETARDED TIMING, WITH AND WITHOUT TRAP, AND WITH LOW AROMATIC FUEL

	Emissions in mg/mi	
	FTP, with trap	FTP, without trap
	Test 9-1	Test 10-1
Benzene	5.4	6.1
Toluene	4.7	4.8
Total Xylenes	1.7	1.8
1,3-Butadiene	ND[a]	ND
Chloroform	ND	ND
1,4-Dioxane	ND	ND
Phosgene	ND	ND

[a]ND-None detected, detection limits are <0.2 mg/mi FTP, <0.1 mg/mi HFET, <1.1 mg/mi NYCC.

APPENDIX O

PARTICULATE ASSOCIATED VOLATILE ORGANICS

TABLE O-1. PARTICULATE ASSOCIATED VOLATILE ORGANICS, MERCEDES BASELINE WITH TRAP

	Particulate Associated Volatile Organics, μg/g Particulate					
	Test 1-3 FTP	Test 1-1 HFET	Test 1-1 NYCC	Test 1-2 FTP	Test 1-2 HFET	Test 1-2 NYCC
Chloromethane	ND[a]	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND
Methylene chloride	ND	ND	ND	ND	ND	ND
Acetone	8	ND	89	ND	ND	ND
Carbon disulfide	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND
Acrolein	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND
2-Butanone	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	*[b]	*	*	*	*	*
Carbon Tetrachloride	ND	ND	**[c]	ND	ND	**
Vinyl acetate	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
2-Chloroethyl vinyl ether	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND
Toluene	3	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND
Styrene	ND	ND	ND	ND	ND	ND
Total Xylenes	ND	ND	ND	ND	ND	ND
Tetrahydrofuran	ND	ND	ND	ND	ND	ND
1,3-Butadiene	ND	ND	ND	ND	ND	ND

[a] ND-none detected - Detection limit 5 μg/g particulate for the FTP and HFET tests, and 10 μg/g particulate for the NYCC tests.
[b] *Found on blank Pallflex filters.
[c] **Higher levels of 1,1,1-Trichloroethane were found to interfere with the analysis of carbon tetrochloride.

TABLE O-2. PARTICULATE ASSOCIATED VOLATILE ORGANICS, MERCEDES BASELINE WITHOUT TRAP

	Particulate Associated Volatile Organics, μg/g Particulate					
	Test 2-1 FTP	Test 2-1 HFET	Test 2-1 NYCC	Test 2-2 FTP	Test 2-2 HFET	Test 2-2 NYCC
Chloromethane	ND[a]	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND
Methylene chloride	ND	ND	ND	ND	ND	5
Acetone	ND	6	ND	ND	ND	ND
Carbon disulfide	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND
Acrolein	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND
2-Butanone	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND
Vinyl acetate	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND
2-Chloroethyl vinyl ether	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND
Styrene	ND	ND	ND	ND	ND	ND
Total Xylenes	ND	ND	ND	ND	ND	ND
1,3-Butadiene	ND	ND	ND	ND	ND	ND
1,4-Dioxane[b]	ND	ND	ND	ND	ND	ND
Phosgene[b]	ND	ND	ND	ND	ND	ND

[a]ND - none detected - Detection limit 1 μg/g particulate for the FTP and HFET tests, and 3 μg/g particulate for the NYCC tests.
[b]Detection limit for 1,4-dioxane and phosgene is 2 μg/g particulate for the FTP and HFET tests, and 6 μg/g for the NYCC tests.

APPENDIX P

MUTAGENIC ACTIVITY RESULTS

Data tables are taken directly from CARB Final Report A-5-130-33 "Genotoxicity of Diesel Exhaust Particles and Vapors Collected from Engines with and without Particulate Trap Oxidizers" by Dr. Ronald Rasmussen of The University of California, Irvine

TABLE P-1. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES WITH TRAP

TABLE 14. Mutagenic Activity in DCM Extracts of Exhaust Particles Collected from Mercedes Benz Auto With an Oxidizer Exhaust Trap Expressed as Revertants per Microgram of Extracted Material.

The values for mutagenic activity are revertants/microgram of extract ± one standard deviation, determined from dose-response curves as described in the Experimental section. The concentrations used for determination of the dose-response were 0, 10, 25, 50, and 75 micrograms/plate, with 3 plates at each concentration. The values for "n" represent the number of plates used to define the linear portion of the dose-response curves, and also indicate the concentration range involved. Thus, an "n" of 6 indicates 0-10 micrograms; "n" of 9 indicates 0-25 micrograms; "n" of 12 indicates 0-50 micrograms; and "n" of 15 indicates 0-75 micrograms.

	Revertants per Microgram*	
Sample No.	TA98 + S9 (n)	TA98 - S9 (n)
With Trap		
6/HFTP	18.9 ± 2.57 (6)	17.9 ± 1.75 (6)
22/ "	4.53 ± 0.95 (6)	7.32 ± 1.37 (9)
10/HFET	9.03 ± 1.16 (9)	13.1 ± 3.58 (6)
26/ "	16.6 ± 1.35 (9)	64.8 ± 2.36 (6)
14/NYCC	4.43 ± 1.65 (6)	3.77 ± 0.99 (6)
30/ "	15.4 ± 0.71 (9)	32.3 ± 0.70 (6)
18/CFTP	5.55 ± 1.31 (9)	5.97 ± 1.05 (9)
34/ "	14.9 ± 2.41 (12)	37.5 ± 2.42 (6)
	TA100 + S9 (n)	TA100 - S9 (n)
6/HFTP	16.1 ± 8.16 (6)	15.9 ± 3.28 (6)
22/ "	2.25 ± 2.62 (9)	3.53 ± 5.60 (6)
10/HFET	13.0 ± 2.90 (6)	12.4 ± 1.19 (6)
26/ "	15.0 ± 2.19 (6)	15.0 ± 4.26 (6)
14/NYCC	4.10 ± 2.97 (6)	3.13 ± 3.55 (6)
30/ "	12.7 ± 3.02 (6)	11.2 ± 3.74 (6)
18/CFTP	5.44 ± 1.12 (9)	6.03 ± 2.33 (6)
34/ "	11.6 ± 2.16 (6)	4.84 ± 2.56 (9)

TABLE P-2. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION, MERCEDES WITHOUT TRAP

TABLE 15. Mutagenic Activity in DCM Extracts of Exhaust Particles Collected from a Mercedes Benz Auto Without an Oxidizer Trap, Expressed as Revertants per Microgram of Extracted Material.

	Revertants per Microgram*			
	TA98 + S9	(n)	TA98 - S9	(n)
42/HFTP	10.2 ± 1.44	(6)	8.80 ± 1.18	(9)
58/ "	9.46 ± 0.88	(9)	12.6 ± 2.29	(6)
46/HFET	22.2 ± 4.49	(9)	23.2 ± 3.85	(9)
62/ "	10.3 ± 1.91	(15)	16.1 ± 5.17	(6)
50/NYCC	9.20 ± 1.38	(9)	9.97 ± 2.28	(9)
66/ "	7.57 ± 1.13	(6)	10.4 ± 2.00	(6)
38/CFTP	34.8 ± 4.51	(6)	36.7 ± 6.42	(6)
54/ "	13.5 ± 1.91	(9)	12.8 ± 4.63	(6)
Blank Filter	0.13 ± 0.23	(15)	-0.30 ± 0.26	(15)
	TA100 + S9	(n)	TA100 - S9	(n)
42/HFTP	12.9 ± 3.97	(6)	4.00 ± 1.14	(15)
58/ "	17.2 ± 3.34	(6)	4.01 ± 0.57	(12)
46/HFET	9.97 ± 5.19	(9)	7.76 ± 4.31	(9)
62/ "	14.1 ± 3.67	(6)	14.5 ± 3.04	(6)
50/NYCC	3.98 ± 1.86	(12)	No Data	
66/ "	7.57 ± 3.66	(6)	12.0 ± 2.91	(6)
38/CFTP	21.1 ± 2.97	(6)	20.7 ± 1.29	(6)
54/ "	13.1 ± 8.59	(9)	5.63 ± 3.14	(12)
Blank Filter	-1.44 ± 0.86	(15)	-0.57 ± 0.62	(15)

*There were no statistically significant differences between the average mutagenic activities when samples collected during the same test cycle, with and without trap, were compared.

TABLE P-3. MUTAGENIC ACTIVITY IN REVERTANTS PER MILE, MERCEDES WITH AND WITHOUT TRAP

TABLE 16. Mutagenic Activity in DCM Extracts of Exhaust Particles Collected from a Mercedes Benz Auto With and Without an Oxidizer Trap Expressed as Revertants/mile of Travel.

Values were calculated using data for miles traveled supplied by SwRI and determinations of extractable material and mutagenic activity at UCI.

	Revertants/Mile x 10^{-3} ± S.D.			
Sample No.	TA98 + S9	TA98 − S9	TA100 + S9	TA100 − S9
With Trap*				
6/HFTP	50.3 ± 6.84	47.7 ± 4.66	42.9 ± 21.7	42.3 ± 8.73
22/ "	14.0 ± 2.94	22.7 ± 4.25	6.97 ± 8.12	10.9 ± 17.3
10/HFET	20.7 ± 2.66	30.1 ± 8.23	29.7 ± 6.64	28.4 ± 2.73
26/ "	40.4 ± 3.29	157 ± 5.72	36.4 ± 5.31	36.4 ± 12.2
14/NYCC	36.1 ± 13.4	30.6 ± 8.07	33.2 ± 24.0	25.4 ± 28.8
30/ "	137 ± 6.32	287 ± 6.24	113 ± 26.9	99.7 ± 33.3
18/CFTP	14.8 ± 3.49	15.9 ± 2.80	14.6 ± 3.01	16.1 ± 6.22
34/ "	80.0 ± 12.9	201 ± 13.0	62.5 ± 11.6	26.0 ± 13.8
Without Trap*				
42/HFTP	323 ± 45.6	229 ± 30.7	336 ± 103	104 ± 29.6
58/ "	255 ± 23.8	338 ± 61.6	464 ± 89.9	108 ± 15.4
46/HFET	480 ± 97.1	501 ± 83.1	215 ± 112	168 ± 93.3
62/ "	260 ± 48.1	406 ± 130	355 ± 92.4	366 ± 76.7
50/NYCC	464 ± 69.6	503 ± 115	202 ± 94.4	No Data
66/ "	371 ± 55.4	510 ± 98.4	371 ± 179	587 ± 142
38/CFTP	1038 ± 135	1095 ± 192	630 ± 88.7	617 ± 38.4
54/ "	454 ± 64.2	431 ± 156	441 ± 289	189 ± 105

*All values without trap are significantly greater than corresponding values with trap; $p<0.0005$.

TABLE P-4. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION, VOLKSWAGEN WITH AND WITHOUT TRAP

TABLE 23. Mutagenic Activity of DCM Extracts of Volkswagen Diesel Exhaust Particles Expressed as Revertants per Microgram of Extracted Material ± 1 S.D.

	Revertants per Microgram			
Sample No.	TA98 + S9	TA98 - S9	TA100 + S9	TA100 - S9
With Trap				
98/CFTP	10.5 ± 1.82	14.7 ± 1.20	8.71 ± 2.27	8.49 ± 3.00
114/ "	5.33 ± 1.52	7.07 ± 1.19	4.49 ± 1.87	5.22 ± 1.87
102/HFTP	8.24 ± 1.57	15.4 ± 1.62	7.70 ± 4.07	13.9 ± 4.05
118/ "	9.88 ± 2.22	12.7 ± 2.69	8.62 ± 3.68	9.67 ± 2.99
106/HFET	19.3 ± 4.20	15.9 ± 3.08	11.2 ± 4.37	14.1 ± 5.10
122/ "	13.3 ± 1.44	18.5 ± 2.54	8.91 ± 4.38	11.8 ± 4.20
110/NYCC	3.76 ± 1.39	4.08 ± 1.87	9.35 ± 6.67	5.33 ± 2.80
126/ "	2.01 ± 1.40	3.21 ± 1.34	4.35 ± 4.48	1.96 ± 2.71
Without Trap				
130/CFTP	19.3 ± 5.81	18.1 ± 2.30	16.8 ± 8.74	14.2 ± 2.19
146/ "	9.36 ± 2.01	14.1 ± 3.17	12.9 ± 2.93	11.5 ± 4.57
134/HFTP	7.30 ± 2.08	8.02 ± 1.91	9.89 ± 2.75	7.91 ± 3.46
150/ "	8.46 ± 2.14	13.4 ± 2.69	11.1 ± 3.43	9.74 ± 3.87
138/HFET	11.3 ± 1.54	19.0 ± 3.34	14.2 ± 3.25	14.8 ± 3.77
154/ "	16.7 ± 2.08	17.6 ± 2.31	13.7 ± 3.87	11.7 ± 3.27
142/NYCC	11.0 ± 3.62	33.4 ± 4.59	13.4 ± 4.69	27.5 ± 3.25
158/ "	6.05 ± 1.78	11.8 ± 2.14	13.1 ± 4.45	7.32 ± 2.96

TABLE P-5. MUTAGENIC ACTIVITY IN REVERTANTS PER MILE, VOLKSWAGEN WITH AND WITHOUT TRAP

TABLE 24. Mutagenic Activity of Volkswagen Diesel Exhaust Particle DCM Extracts Expressed as Revertants/mile of travel.

Sample No.	Revertants/Mile x 10^{-3} ± S.D.			
	TA98 + S9	TA98 - S9	TA100 + S9	TA100 - S9
With Trap*				
98/CFTP	99.1 ± 17.2	139 ± 11.3	82.1 ± 21.4	80.0 ± 28.3
114/ "	29.4 ± 8.38	39.0 ± 6.56	24.7 ± 10.3	28.9 ± 10.4
102/HFTP	83.6 ± 15.9	156 ± 16.4	78.5 ± 41.5	141 ± 41.1
118/ "	69.2 ± 15.5	89.3 ± 18.9	60.4 ± 25.8	68.1 ± 21.1
106/HFET	129 ± 28.1	106 ± 20.5	75.0 ± 29.3	94.2 ± 33.4
122/ "	62.3 ± 6.74	86.7 ± 11.9	41.6 ± 20.4	55.2 ± 19.6
110/NYCC	52.4 ± 19.4	56.9 ± 26.1	131 ± 93.4	74.3 ± 39.0
126/ "	25.0 ± 17.4	40.1 ± 16.7	54.0 ± 55.6	24.3 ± 33.6
Without Trap*				
130/CFTP	721 ± 217	676 ± 193	627 ± 326	528 ± 81.4
146/ "	401 ± 86.1	604 ± 136	553 ± 126	493 ± 196
134/HFTP	296 ± 84.3	325 ± 77.4	402 ± 167	321 ± 115
150/ "	338 ± 85.5	537 ± 108	444 ± 137	391 ± 155
138/HFET	252 ± 34.3	422 ± 74.2	316 ± 72.3	330 ± 84.1
154/ "	348 ± 43.3	368 ± 48.3	284 ± 80.2	244 ± 68.2
142/NYCC	656 ± 216	1988 ± 273	798 ± 279	1635 ± 193
158/ "	359 ± 106	705 ± 128	782 ± 266	436 ± 176

*All values without trap greater than corresponding values with trap; $p<0.0005$.

TABLE P-6. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION AND IN REVERTANTS PER MILE, MERCEDES WITH LOADED TRAP

<u>TABLE 28.</u> Mutagenic Activity of a DCM Extract of Exhaust Particles Collected from a Mercedes Benz Diesel Auto Operating with a Loaded Oxidizer Trap.

Particles were collected on teflon-coated glass fiber filters during the NYCC driving cycle, using baseline fuel (high aromatic). This is sample number 1280-70 from the SwRI. Extraction and mutagenesis testing were as previously described. The values for revertants per microgram of extract and for revertants per mile were calculated based on the linear portion of a dose response curve obtained with concentrations of 0,5,10,20 or 40 micrograms of extract per plate, with 3 replicate plates at each concentration. The number in parentheses following the values for revertants per microgram is the number of plates used to define the linear portion of the dose-response curve, and also indicates the concentration range involved. Thus, "15" indicates a range of 0-40 micrograms, "12" a range of 0-20 micrograms, "9" a range of 0-10 micrograms, etc.

<u>Revertants per Microgram ± S.D.</u>

Strain TA98 + S9: 5.97 ± 1.05 (15)   TA98 - S9: 6.96 ± 1.21 (15)

Strain TA100 + S9: 5.29 ± 1.30 (15)   TA100 - S9: 3.71 ± 1.62 (12)

<u>Revertants per Mile Traveled x 10^{-3} ± S.D.</u>

Strain TA98 + S9: 122 ± 21.5   TA98 - S9: 151 ± 26.2

Strain TA100 + S9: 139 ± 24.6   TA100 - S9: 72.0 ± 31.4

<u>Negative Controls.</u> Values are the mean ± S.D. of the number of spontaneous revertants on triplicate plates which received the DMSO solvent only.

TA98+S9:	44.7 ± 3.21	TA100+S9:	153 ± 17.5
TA98-S9:	36.3 ± 6.66	TA100-S9:	190 ± 5.86

<u>Positive Controls.</u> Values are revertants per microgram of compound as in Table 12.

Strain TA98 + S9 + 2AF: 64.6 ± 25.3
Strain TA98 - S9 + 2NF: 853 ± 138

Strain TA100 - S9 + MMS: 17.5 ± 2.06

TABLE P-7. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION AND REVERTANTS PER MILE, MERCEDES REGENERATION WITH BASELINE FUEL

TABLE 29. Mutagenic Activity of DCM Extracts of Exhaust Particles Collected from a Mercedes Benz Auto During Oxidizer Trap Regeneration.

Particles were collected during the HFET driving cycle while using baseline (high aromatic) fuel. These are samples #1280-74 and 1280-78 from the SwRI. Values are as in Table 28.

Revertants per Microgram of Extract ± S.D.

#	TA98 + S9	TA98 - S9
74	15.2 ± 2.45 (15)	30.6 ± 4.16 (12)
78	7.60 ± 1.27 (15)	14.3 ± 2.25 (12)
	TA100 + S9	TA100 - S9
74	19.7 ± 2.67 (9)	13.0 ± 1.82 (15)
78	12.4 ± 3.73 (9)	11.1 ± 4.03 (9)

Revertants per Mile of Travel x 10^{-3} ± S.D.

#	TA98 + S9	TA98 - S9
74	106 ± 17.1	176 ± 24.0
78	29.0 ± 4.85	54.0 ± 8.50
	TA100 + S9	TA100 - S9
74	114 ± 15.4	75.0 ± 10.5
78	47.0 ± 14.2	42.0 ± 15.3

Negative Controls and Positive Controls are the same as in Table 28.

TABLE P-8. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION AND IN REVERTANTS PER MILE, MERCEDES WITHOUT TRAP AND WITH LOW AROMATIC FUEL

TABLE 30. Mutagenic Activity of DCM Extracts of Exhaust Particles Collected from a Mercedes Benz Auto During Baseline Tests with Low Aromatic Fuel.

Particles were collected during test cycles CFTP and HFTP without an oxidizer trap. These are samples #1280-82, 1280-90, 1280-86, and 1280-94 from the SwRI. Values are as in Table 28.

Revertants per Microgram of Extract ± S.D.

#	TA98 + S9	TA98 - S9
82(CFTP)	11.1 ± 4.03 (15)	15.2 ± 2.39 (12)
90(CFTP)	8.94 ± 1.52 (15)	15.4 ± 2.45 (12)
86(HFTP)	8.48 ± 0.980 (15)	10.7 ± 1.34 (12)
94(HFTP)	4.46 ± 1.12 (15)	10.9 ± 1.80 (12)
	TA100 + S9	**TA100 - S9**
82(CFTP)	14.2 ± 1.90 (15)	7.93 ± 1.54 (12)
90(CFTP)	11.6 ± 2.79 (15)	9.00 ± 1.31 (12)
86(HFTP)	5.90 ± 1.75 (15)	7.71 ± 2.91 (12)
94(HFTP)	5.02 ± 1.79 (15)	10.9 ± 1.80 (12)

Revertants per Mile of Travel ± S.D. x 10^{-3}.

#	TA98 + S9	TA98 - S9
82(CFTP)	306 ± 43.9	418 ± 65.6
90(CFTP)	246 ± 41.8	424 ± 67.4
86(HFTP)	183 ± 21.1	230 ± 18.9
94(HFTP)	95.0 ± 23.9	233 ± 38.4
	TA100 + S9	**TA100 - S9**
82(CFTP)	390 ± 52.0	218 ± 42.3
90(CFTP)	320 ± 76.8	248 ± 36.1
86(HFTP)	127 ± 37.7	166 ± 62.6
94(HFTP)	107 ± 38.2	94.0 ± 46.0

Negative Controls. Values are the mean ± S.D. of the number of spontaneous revertants on triplicate plates which received the DMSO solvent only.

TA98+S9:	57.7 ± 8.50	TA100+S9:	153 ± 21.7
TA98-S9:	43.3 ± 8.20	TA100-S9:	159 ± 9.24

Positive Controls. Values are revertants per microgram of compound ± 1 S.D., as in Table 12.

Strain TA98 + S9 + 2AF: 58.7 ± 5.51
Strain TA98 - S9 + 2NF: 1236 ± 110

Strain TA100 - S9 + MMS: 17.5 ± 1.02

TABLE P-9. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION AND IN REVERTANTS PER MILE, VOLKSWAGEN WITH LOADED TRAP

TABLE 31. Mutagenic Activity of a DCM Extract of Diesel Exhaust Particles Collected from a Volkwagen Auto Operating with a Loaded Oxidizer Trap.

Particles were collected during a NYCC driving cycle using baseline high aromatic fuel. Extraction and mutagenesis testing were as previously described. This is sample #1280-162 from the SwRI. The values are as in Table 28.

Revertants per Microgram of Extract ± S.D.

Strain TA98 + S9: 18.4 ± 2.02 (15) TA98 - S9: 25.8 ± 4.15 (12)

Strain TA100 + S9: 15.5 ± 3.05 (12) TA100 - S9: 18.5 ± 7.94 (9)

Revertants per Mile of Travel ± S.D. x 10^{-3}.

Strain TA98 + S9: 845 ± 93.0 TA98 - S9: 1190 ± 191

Strain TA100 + S9: 716 ± 140 TA100 - S9: 854 ± 366

Negative Controls. Values are the mean ± S.D. of the number of spontaneous revertants on triplicate plates which received the DMSO solvent only.

TA98+S9:	42.0 ± 6.08	TA100+S9:	133 ± 24.2
TA98-S9:	36.3 ± 4.93	TA100-S9:	127 ± 18.6

Positive Controls. Values are revertants per microgram of compound as in Table 12.

Strain TA98 + S9 + 2AF: 85.3 ± 14.3
Strain TA98 - S9 + 2NF: 1320 ± 172

Strain TA100 - S9 + MMS: 8.42 ± 3.33

TABLE P-10. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION AND IN REVERTANTS PER MILE, VOLKSWAGEN REGENERATION WITH BASELINE FUEL

TABLE 32. Mutagenic Activity of DCM Extracts of Diesel Exhaust Particles Collected from a Volkswagen Auto During Oxidizer Trap Regeneration.

Particles were collected during the HFET driving cycle using baseline (high aromatic) fuel. Extraction and mutagenesis testing were as previously described. These are samples #1280-166 and 1280-174 from the SwRI. Values in the Table are as in Table 28.

Revertants per Microgram of Extract ± S.D.

#	TA98 + S9	TA98 − S9
166	36.2 ± 5.13 (15)	60.8 ± 10.3 (12)
174	53.2 ± 10.9 (12)	71.5 ± 14.4 (12)
	TA100 + S9	TA100 − S9
166	21.0 ± 5.68 (12)	15.1 ± 4.19 (12)
174	31.9 ± 5.04 (12)	25.5 ± 10.5 (9)

Revertants per Mile of Travel ± S.D. x 10^{-3}.

#	TA98 + S9	TA98 − S9
166	788 ± 112	1320 ± 223
174	554 ± 113	745 ± 150
	TA100 + S9	TA100 − S9
166	457 ± 124	329 ± 91.0
174	332 ± 52.5	266 ± 109

Negative Controls and Positive Controls are as in Table 31.

TABLE P-11. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION AND IN REVERTANTS PER MILE, VOLKSWAGEN WITH TRAP AND LOW AROMATIC FUEL

TABLE 33. Mutagenic Activity of DCM Extracts of Diesel Exhaust Particles Collected from a Volkswagen Auto Equipped with an Oxidizer Trap During Baseline Tests with Low Aromatic Fuel.

Particles were collected during CFTP and HFTP driving cycles using a low aromatic fuel (16.2% Aromatics). Extraction of particles and mutagenesis testing were as previously described. These are samples #1280-178, 1280-186, 1280-182, and 1280-190 from the SwRI. Values in the Table are as in Table 28.

Revertants per Microgram of Extract ± S.D.

#	TA98 + S9	TA98 - S9
178(CFTP)	30.1 ± 2.52 (15)	40.9 ± 6.31 (12)
186(CFTP)	12.6 ± 2.42 (12)	20.5 ± 5.43 (12)
182(HFTP)	12.2 ± 1.52 (15)	16.2 ± 2.48 (15)
190(HFTP)	8.19 ± 1.24 (15)	8.88 ± 1.75 (15)
	TA100 + S9	TA100 - S9
178(CFTP)	18.6 ± 2.56 (15)	10.6 ± 3.12 (12)
186(CFTP)	9.15 ± 1.83 (12)	9.97 ± 3.36 (12)
182(HFTP)	8.02 ± 1.15 (15)	6.97 ± 3.62 (9)
190(HFTP)	4.94 ± 1.72 (15)	5.96 ± 2.29 (12)

Revertants per Mile of Travel ± S.D. x 10^{-3}

#	TA98 + S9	TA98 - S9
178(CFTP)	162 ± 13.6	221 ± 34.1
186(CFTP)	59.0 ± 11.3	97.0 ± 25.6
182(HFTP)	51.0 ± 6.36	67.0 ± 10.2
190(HFTP)	29.0 ± 4.39	31.0 ± 6.11
	TA100 + S9	TA100 - S9
178(CFTP)	100 ± 13.8	57.0 ± 2.32
186(CFTP)	43.0 ± 8.60	47.0 ± 15.8
182(HFTP)	33.0 ± 4.73	29.0 ± 15.1
190(HFTP)	17.0 ± 5.42	21.0 ± 8.07

TABLE P-12. MUTAGENIC ACTIVITY IN REVERTANTS PER MICROGRAM OF PARTICULATE SOLUBLE ORGANIC FRACTION AND IN REVERTANTS PER MILE, VOLKSWAGEN WITHOUT TRAP AND WITH LOW AROMATIC FUEL

TABLE 34. Mutagenic Activity of DCM Extracts of Diesel Exhaust Particles Collected from a Volkwagen Auto Without an Oxidizer Trap During Baseline Tests with Low Aromatic Fuel.

Particles were collected during CFTP and HFTP driving cycles. Extraction of particles and mutagenesis testing were as previously described. These are samples 1280-194, 1280-202, 1280-198 and 1280-206 from the SwRI. Values in the Table are as in Table 28.

Revertants per Microgram of Extract ± S.D.

#	TA98 + S9	TA98 − S9
194(CFTP)	8.05 ± 0.936 (15)	9.67 ± 1.48 (15)
202(CFTP)	10.8 ± 1.41 (15)	15.2 ± 3.42 (12)
198(HFTP)	9.04 ± 1.45 (15)	12.8 ± 1.73 (15)
206(HFTP)	10.2 ± 1.32 (15)	21.5 ± 3.41 (12)

#	TA100 + S9	TA100 − S9
194(CFTP)	7.89 ± 1.40 (15)	8.11 ± 1.42 (15)
202(CFTP)	8.26 ± 2.35 (15)	8.84 ± 2.07 (15)
198(HFTP)	13.7 ± 5.41 (9)	8.69 ± 1.11 (15)
206(HFTP)	11.1 ± 3.94 (12)	12.8 ± 2.13 (15)

Revertants per Mile of Travel ± S.D. x 10^{-3}

#	TA98 + S9	TA98 − S9
194(CFTP)	208 ± 24.2	250 ± 38.3
202(CFTP)	327 ± 42.8	461 ± 104
198(HFTP)	215 ± 34.5	305 ± 41.1
206(HFTP)	188 ± 24.2	397 ± 63.0

#	TA100 + S9	TA100 − S9
194(CFTP)	204 ± 36.2	209 ± 36.6
202(CFTP)	251 ± 71.4	268 ± 62.8
198(HFTP)	325 ± 129	206 ± 26.3
206(HFTP)	205 ± 72.8	199 ± 39.3